An Investigation into the Users' Perceptions of Engaged Learning regarding the Australian Maritime College's Ship Handling Simulator

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Statement of Authenticity

This dissertation contains no material which has been accepted for a degree or diploma by the University or any other institution, except by the way of background information and duly acknowledged in the Thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the Thesis.

Sam Lee,

May, 2004.

Abstract

Empirical research have often criticise the weaknesses of passive learning approaches to student learning i.e. traditional lecture-based and classroom-based methods, and that it falls short in many areas. These areas include the inability to accommodate a wide variety of learning styles; support of differing skills and learner capabilities of individuals; and effectively assist learners to understand complex or ill-structured problems. However, the arrival and impact of technology into education institutions have shifted the traditional paradigm of teaching and student learning. One such technology is the computer simulator.

The computer simulator is designed to facilitate user-centric learning for specific applications in a simulated, virtual environment. However, relatively little research is conducted into how the simulator engage users, and specifically, the impact it has on the perceptions of higher education learners. This research explores the perceptions of engaged learning held by students of the Australian Maritime College (AMC), particularly in a team-oriented setting, in employing the use of the ship handling bridge simulator. The aim is to reveal selected participants' underlying attitudes, beliefs and perceptions to better understand the impact of student simulation learning.

The findings from this research program will provide insight into why the AMC's ship handling simulator is so highly regarded by its students and the influence it has on the users' mindsets and behaviour towards learning. It may have contributed to why the simulation program has been so successful since its inception approximately four years ago.

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Launceston, May 28th 2004.

Table of Contents

List of Tables

List of Figures

Chapter One

Introduction

> *"A fool's brain digests philosophy into folly, science into superstition, and art into pedantry. Hence, University education."*
> **George Bernard Shaw (1856-1950)**

1.0 Chapter One - Introduction

This thesis explores the perceptions of engaged learning held by selected students of the Australian Maritime College (AMC), particularly in a team-oriented setting, in employing the use of computer-based simulations. The aim is to reveal his or her underlying attitudes, beliefs and perceptions regarding the Australian Maritime College's ship handling simulator.

The methodology chosen for this study is via a qualitative, interpretive approach. Nine AMC students from various backgrounds were chosen as voluntary participants. The data gathering process comprised of two field research techniques: observations and semi-structured interviews. The observations conducted were to better understand the ship handling simulation program and the participants in their natural environment. Secondly, the users' experiences and understanding of this phenomenon were attained through individual, semi-structured interviews.

A three stage data coding process was utilised as the method of data analysis and interpretation. This bottom-up approach was to seek any emergent patterns and themes from the interviews with the participants. Also, categorical aggregation was employed to develop the hierarchy of core categories.

This chapter introduces the background and purpose for this study. It also provides an outline of the thesis structure.

1.1 Background Information

Traditional theory underlying many of today's learning and teaching methodologies is considered by educators and academics to be ineffective (Jenkins, 1994; Gasen, Roberts et al., 1996; Mills-Jones, 1999; Cornelius, 2000; Costello, 2001; Alberta, 2003), and even inappropriate in some cases, for the rigors and demands of the new generation of learners. They are unable to cope with the realities of the 21st century, such as, the growing sophistication and demands of learners, budding class sizes, addressing ill-structured problems and mounting emphasis on user-centred learning.

1.1.1 Engaged Learning

The fundamental concept underlying engaged learning is that students must be fully engaged in learning activities through interaction with others and undertaking meaningful tasks. While this is possible without the utilisation of technology, it can increase the capabilities of facilitating engagement in ways which are difficult to achieve otherwise (Papert, 2003), especially, when it involves complex or ill-structured activities. Thus, engagement theory is intended to be a conceptual framework for technology-based teaching and learning.

Engaged learning is different from many older models of computer-based learning, which focused on individualised instruction and interactivity (Kearsley and Shneiderman, 1999), rather than promoting human interaction in the context of group activities and not just prominence on individual interaction with an instructional program. Another key difference between engaged learning and many previous user/teaching learning models is the perception of technology as a communication and learning tool rather than some form of delivery device only (Kearsley and Shneiderman, 1999). In addition, it places great emphasis on providing a meaningful setting for learning, not present in previous models.

1.1.2 Computer-based Simulators

According to Nadler and Nadler (1994), computer-based simulation can be generally defined as an artificial situation, or environment, designed to allow learners to try out new behaviour and actions without real-world consequences. Already simulation technology today is, in most cases, readily accepted over the real thing where exposure to real events or equipment is too dangerous, too costly or where original events are inaccessible because of constraints including time, distances or resource (Dowling, 1997).

Instructional methods, such as simulators, offer a powerful vehicle for transferring learning in areas including communication, decision making, and conflict, and are highly influential in skill development (Cunningham, 1984). It helps learners attain objectives more effectively than other methods because they provide not only experiential learning, as described later on, but also performance-oriented learning enabling learners to observe the required behaviour to engage in practise, to receive immediate feedback and remediation (Jacobs and Baum, 1987).

1.2 The Impetus for the Research

The purpose of this study is to investigate the perceptions of higher education users regarding engaged learning in an advanced, computer simulation environment. The impelling forces behind this study were the informal discussions between colleagues and friends about the success of Australian Maritime College's (AMC) ship-handling simulator, and how it has often be praised for not just its technology but the ability to deliver high learning outcomes. I have always been fascinated at the rapid pace of technological developments, and how it can transform lives given the right opportunity and circumstances. As such, I was both curious and intrigued to investigate AMC's ship handling simulator and to understand the perceptions held by users in what they believe engaged them in the learning process.

1.3 Why Explore the Phenomenon of Computer Simulation Systems and Engaged Learning?

There is a growing concern amongst academics and educators that traditional models and methods of learning are not aligned with the educational needs of students in the 21st century (Jones, Valdez et al., 1994). Coupled with the ever-changing demands of learners and technological developments, the old learning models is struggling to educate students, which adopts and utilise the old passive learning environment that places heavy focus on a teacher-centred approach. This is in contrast to the present era of where there is a rhetorical shift to student-centred learning and support for more of an active approach to learning activities, typically, facilitated by technology. As such, fundamental changes are required from educators to meet the needs for a new generation of student learners.

The exploration into engaged learning is one of many critical steps required to address this imbalance. It will hopefully inspire greater performance in students, and which the status quote, and scores of other learning methodologies have previously failed. Furthermore, since students have differing learning styles, that evolve overtime, it is important to recognise this diversity and find ways to accommodate it.

The computer simulation sector is certainly not new as it has been an application of computer systems for over six decades. It is an immersive technology that allows users to solve problems and achieve objectives through Just in Time (JIT) teaching and asynchronous learning. Under these circumstances, self-guided discovery and experience becomes the best teacher (Papert, 2003). Although advanced, full scale simulators have primarily been in the past utilised by the military, it has developed to a point where it is feasible and cost-effective to be used in schools to help students learn. In addition, it is an area where current engaged theory has not done any extensive tests to evaluate existing findings, particularly, at higher education levels.

1.4 Research Justification

The research outcomes will have significant value to industry, businesses and Government who may wish to understand the users' perception of engaged learning in a team-oriented, simulation environment. The current literature on technology facilitated engaged learning is very much limited to a few technologies and applications including the use of e-mail, online conferencing, web databases, groupware, and audio/videoconferencing. Thus, the theories and results cannot be generalised to technology-based learning outside this scope. Furthermore, computer-based simulations are a tool that not only delivers learning, as opposed to a majority of tools used to underpin electronic learning (or e-learning), but can also assess the learner's skills and performance. By taking such an in-depth approach in this research, insights can be gained on how current team simulation programs are designed to educate or train users in team settings related to the maritime industry.

The results from the study can influence how organisations, such as, the Australian Maritime College implement simulation programs in the future. Educators can take on board information that will aid them in making future decisions such as:

- Effective user-centric processes and functions;
- Content requirements;
- Implementing process indicators and measurements.

Furthermore, the study attempts to contribute to the current existing body of knowledge in this field and to improve the learning of users in simulation environments where participants work not only as individuals but also in teams.

1.4.1 Research Questions

The main purpose of the study is to answer two specific research questions:

1. *How does computer-based simulation help facilitate engaged learning for the higher education participants in this research program, using the ship handling simulator at the Australian Maritime College?*

2. *How do the higher education participants perceive the role of the Australian Maritime College's ship handling simulator in their learning process, particularly in a team setting, and how do these perceptions influence their learning?*

1.5 Thesis Structure

In this chapter, the purpose, impetus and aims of the study are outlined.

Chapter two reviews and discusses the literature surrounding the topic of computer-based simulations, the importance of engaged learning, perceptions held by academics and users on differing learning methods and strategies, and outlines areas of neglect and strengths in the existing body of knowledge.

Chapter three describes the methodological issues including the research design and the participant selection process used in this research program. It also explains the choice of method, how data was gathered and the strategy used for data analysis.

Chapter four offers an in-depth examination of the analytical process of how the interview transcripts are coded. Furthermore, it offers readers a detailed description of the participants in their natural learning environment through the eyes of the researcher.

Chapter five focuses on the discussion of the findings. It includes a profile of the nine interviewed participants to provide the reader a useful background and establish a chain of evidence to support the derived core categories and sub-themes.

Chapter six presents a general summary of the core categories and highlights any important findings from the study. Furthermore, the key findings are compared and contrasted to the current existing literature. It also aims to draw conclusions according to the research questions and discuss the limitations of this research program.

Chapter Two

Literature Review

"There are only two ways to live your life. One is as though nothing is a miracle. The other is as though everything is a miracle."
Albert Einstein (1879-1955)

2.0 Chapter Two – Literature Review

2.1 Chapter Introduction

The aim of this chapter is to discuss the literature that is relevant to this study and its relationship with the research goals. The amount of published material devoted to the subject of computer-based simulations is fairly extensive including research papers, articles, dissertations, and essays but coupled with the issue of engaged learning is somewhat limited.

This chapter discusses issues surrounding the use of computer simulation systems and the general use of technology in learning. For example, it will review previous works and findings completed in areas including engaged learning, learning theories and teaching and learning paradigms. Finally, it will conclude with a profile on the Australian Maritime College's ship handling simulator.

2.2 Traditional Learning Environment

The learning that transpired in schools is traditionally deemed an individual activity, and often criticised in literature as being an ineffective instructional approach (Rashty, 2000). It is the result of factors, such as, traditional learning environments being based on the assumption that teaching is built on a foundation of teaching basic information and knowledge; the goal to only allow students to achieve a specific, pre-planned objective (Marcum, 1994); to digest factual and other knowledge materials and show that it exists in their usable memory; the diversity of student populations and the expectations of students have increased (Saunders, 2000); and developments in information and communication technology (ICT) have generally led to different and more flexible approaches to learning. As such, according to researchers at the Education Society of Alberta (2003), this traditional learning environment typically produce two outcomes:

- Knowledge that students attain is associated only in the context that they learn in, and not associated with real-world or meaningful problems;
- Students master information through drill and practise.

This is in contrast to the present literature that suggests the characteristics of an effective or high achieving learning environment would need advanced instructional techniques to support learning. According to Peterson (1994), in an effective learning environment students play an active role - instead of a passive one - in their learning process: where teachers engaged students in complex problem-solving exercises; explore new ideas and issues; undertake activities that draw on the students' culture, experiences, and knowledge; and be ideally facilitated by ICT where appropriate. The outcome is to give learners an opportunity to construct knowledge – not just to memorise it – and to teach all students basic skills and demanding, high ordering thinking skills (Peterson, 1994). Thus, their work is authentic, engaging and it builds understanding from in-depth examination and exploration.

It is also important to note that it is difficult for some institutions to employ new learning and teaching styles and practises as Wise (1997) explains in a report, *Task Force on Technology and Teacher Education*, that:

> *"...teachers may be forgiven if they cling to old models of teaching that have served them well in the past. All of their formal instruction and role models were driven by traditional teaching practices. Breaking away from traditional approaches to instruction means taking risks and venturing into the unknown. But this is precisely what is needed at the present time."*

2.2.1 Traditional and New Learning Environments in the Digital World

The question at the centre of institutional and personal decisions related to adoption of technology-infused teaching and learning: does technology improve learning? In the current literature few would argue against the merits of technology in student learning and have praised a number of positive changes that has occurred since its inception. For example, in the 2001 report *Key Building Blocks for Student Achievement in the 21st Century* published by the CEO forum, suggested that education facilitated by technology improved or gave learners skills including inventive thinking, digital literacy, effective communication and teamwork (Nevens, Rodrigues et al., 2001). More importantly, it highlighted the need for reform, not just in the curriculum and the teaching approach, but also in the mindsets of educators to address the needs of students by taking advantage of what ICT offered.

The International Society of Technology in Education (ISTE) (2000) developed a learner-centred model called "*New Learning Environments*" which was a response to a growing consensus amongst researchers and education institutions that "*...student-centred, constructivist and collaborative learning is more effective learning than the traditional top-down, lecture-based, text-driven model*". It identified significant changes to the learning environment (*see Table 2.1*).

Traditional Learning Environment	New Learning Environment
Teacher-centred instruction	Student-centred learning
Single-sense stimulation	Multi-sensory stimulation
Single-path progression	Multi-path progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Passive learning	Active, exploratory, or inquiry-based learning
Factual, knowledge-based learning	Critical thinking and informed decision-making
Reactive response	Proactive or planned action
Isolated, artificial context	Authentic, real-world context

Table 2-1 Comparison of traditional and new learning environments

(Source: International Society of Technology in Education (ISTE), 2000)

The ISTE also argue that traditional assessment do not fully measure the range of 21st century skills, are not aligned with any recognised standards and place too much focus on lower order thinking skills. Instead, the ISTE recommended that students develop higher order skills, such as, critical or problem solving skills.

2.2.2 A Higher-Education Learning Model

Traditional pedagogy of higher education utilises the lecture-based model as the most common means of face-to-face instruction (Mills-Jones, 1999), especially in the large class setting (see *figure 2-1*), which often placed high emphasis on the transmission of factual data and skills from a teacher to a student (Scott and Hamada, 2000). This is based on the assumption that knowledge is a tangible and transferability entity. However, studies have proven this assumption to be incorrect as studies (for example, Lave, 1991; Sumner, 1995) have shown that adult learning is inextricably intertwined with multidirectional activities i.e. work and play, and that learning is essentially a social activity. They suggest that the process of acquiring knowledge cannot be separated from the process of applying it because knowledge is temporary, developmental, and socially and culturally mediated.

Nonetheless, lecture based models will suit some audiences as O'Connor (1997) illustrates that auditory learners will learn well in lecture settings and private learners will gain knowledge from quiet reading. However, these are just two out of a broad array of preferences, and when students are only limited to these modes, they are bound not to achieve their learning potential (O'Connor, 1997). Other criticism include a lack of feedback from the student to the lecturer, poor recall of lecture material, inability to sustain student attention, and the notion that all students learn at the same rate with the same level of understanding and adopt similar learning strategies (Jenkins, 1994; Nelson, 1999). As a result, it may inhibit one or more clusters of learners who are forced to absorb knowledge with lower motivation and ability.

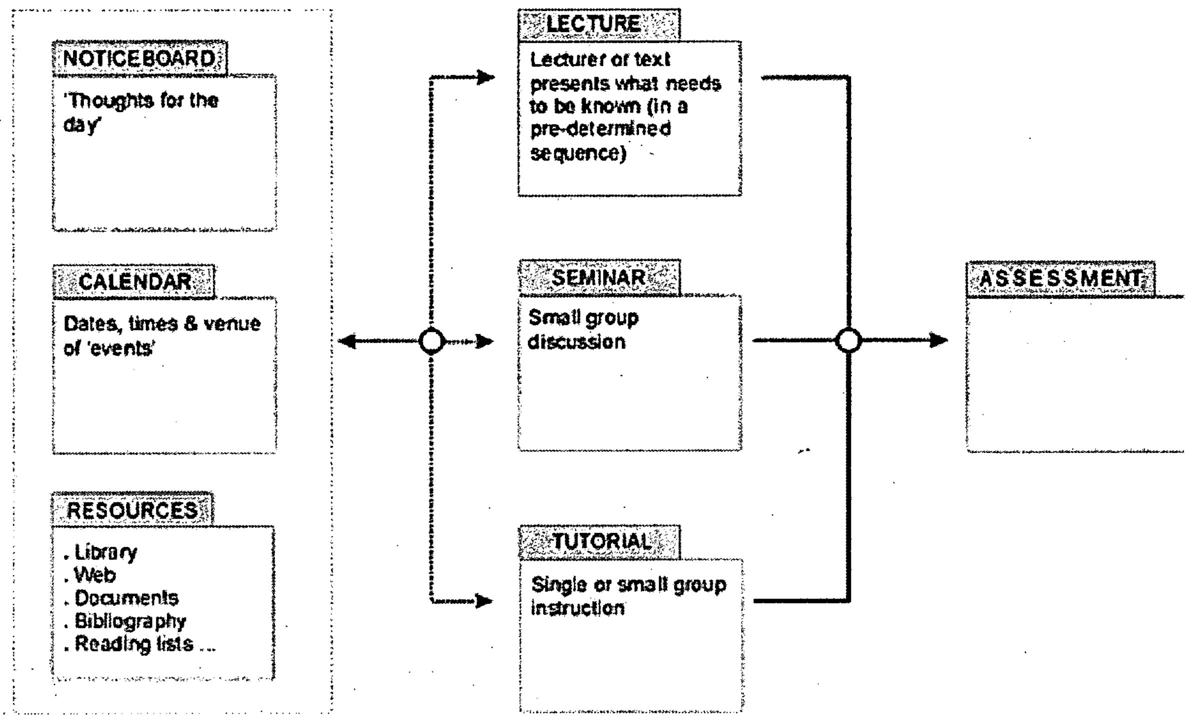

Figure 2-1 Lecture-based Learning Model

2.3 Evolution of Computer-based Simulations

The evolution of computer-based simulators has its roots dating back almost six decades. In the late 1950s, a young electrical engineer, and former naval technician, named Douglas Engelbart envisioned computers as being more than just machines limited to number crunching applications but also as a tool for digital display (EVL, 1995). However, Engelbart's idea was initially dismissed until the early 1960s when there was a greater consensus and support for the idea. It was also during that period communication technology began to merge with computing and graphics technology, and where the first computers were based on transistors rather than vacuums (EVL, 1995) enabling more complex computing tasks to be completed.

Several pivotal events ensured the prominence of computer simulators in the 1970s and 1980s including the fear of nuclear attacks during the Cold War prompted the US Government to develop a "*radar defence system with "real time," or instantaneous, simulation of data*" (EVL, 1995; Wikipedia, 2003); aircraft designers began experimenting with computers to graphically display or model air flow data ; and efforts to model the process of nuclear detonation by the US military. Eventually, in less than a decade, one of the most influential antecedents of computer-based simulators was born: the flight simulator. The flight simulator offered alternative methods to train pilots, in a safe environment, before subjecting them to hazards of light, and most importantly, at a significantly lower cost. Again, it was the US military who led the forefront in employing the flight simulator that would later extend to simulating tank and maritime applications.

In the last two decades, the driving force behind the continuous development of computer simulators have shifted away from the US military to the private sector, driven by the demand from private enterprises in developing applications for specific roles or tasks, which was deemed too costly or dangerous for learners. The shift was also evidence of the technology maturing and establishing itself beyond military use.

2.4 Computer-based Simulations

For decades, commercial enterprises and academics have investigated the value, and made use, of authentic, simulated environments where users can examine ill-structured or complex problems (Hart and Barden-Gabbei, 2002). However, it was often restricted to a few applications because of costs and technical limitations. But this changed as technology costs lowered and became more readily available. Furthermore, the increase in its popularity and adoption was also contributed from a rhetorical shift from teacher-centred to learner-centred learning that made educators rethink program and content delivery, and growing support to reconceptualise student learning by grounding theoretical and empirical knowledge into problems of practise (Ng, Chong et al., 2001).

According to Nadler and Nadler (1994), computer-based simulation can be generally defined as an artificial situation or environment designed to enable learners to try out new behaviour without the real-world punishment. Already simulation technology today is, in most cases, readily accepted over the real thing, especially where exposure to real events or equipment is too dangerous, too costly, or where original events are inaccessible because of constraints such as time, distances or resource (Dowling, 1997). Also, it enhances skill development and transfer of learning without jeopardy to employees, the organisation or equipment.

Computer simulation systems are emerging as a new generation of e-learning tools. E-Learning seeks to bring and impart knowledge to the learner through the use of modern technology. The key differentiator between typical e-learning tools and computer simulations is that the simulator is both the learning and assessment tool (Brown, 2002:34). The value of simulator as a learning tool stems from the interaction between the user and the artificial environment, and the related interaction that arise from it. A user becomes engaged by and absorbed in the simulation. Once engaged, the user is doing, and research by Jean Piaget highlights that '*doing is the best way to learn*'. One of her research conclusions indicate that after two months of using simulation applications, a learner will typically remember: 20 percent of what they hear; 30 percent of what they see; 70 percent of they say; and 90 percent of that they do.

Gentry (1991) also explains that computer-based simulations is an instructional training and learning application that falls under the category of experiential learning pedagogues, contextual learning theory and information processing theory. The linkage between computer simulations to these theories is that simulation is an attempt to represent the real world. Thus, it gives meaning to areas of experiential learning and contextual learning because the learner's cognitive understanding of what is learned is in direct relation to the context of the experience of the individual (Ng, Chong et al., 2001). Furthermore, since computer simulation is an attempt to model particular aspects of a real world, one key benefit is the learner's ability to see a series of connections to what is learnt and what they actually experienced (Ng, Chong et al., 2001).

Instructional methods, such as simulators, offer a powerful vehicle for transferring learning in areas including communication, decision making and conflict, and they are relevant for skill development (Cunningham, 1984). It helps learners attain objectives more effectively than other methods because they provide not only experiential learning, as described later on, but also performance-oriented learning enabling learners to observe the required behaviour, to engage in practise, to receive immediate feedback and remediation (Jacobs and Baum, 1987).

Although there are significant value in utilising computer simulations in learning and teaching, there are also risks and disadvantages associated in its adoption. For example, the amount of finance and resources required to maintain a computer simulation program is still relatively high; the technology is very goal specific and is not suitable for all i.e. face-to-face approach; and the more complex the phenomenon, the higher probability of errors in capturing its behaviour (Gentry, 1991).

The advantages of simulations include that it is psychologically safe for the user so the pressure associated with real-life performances can be minimised to encourage experimentation, creativity and risk taking because the consequence of error is minimal (Clariana, 1989). Secondly, it can help students become effective learners since they can see the consequence of their actions immediately, and effectively employ selection and process strategies (Ng, Chong et al., 2001). Finally, As Min (2000) explains that only when computer simulations is appropriately alternated with other didactic forms, will it render a positive result. He also comments that no educational tool is effective for everyone, and so a differential supply of educational support tools is important.

2.4.1 Basic Structure of a Computer Simulation

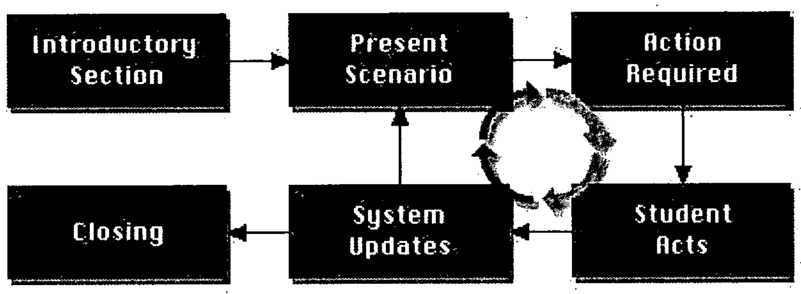

Figure 2-2 Basic Structure of a Simulation
(Source: McNeil, 2003)

Figure 2-2 illustrates the basic structure of a computer simulation, and outlines the core processes in how the system manipulates its responses according to the learner's actions. Within the model is a cycle where the simulation generates a scenario that requires input or response from the user, elicits the user to act and the system updates/reacts accordingly. The cycle continues until the scenario ends.

2.4.2 Types of Simulations

There are basically two main types of simulations: tactical decision simulations and social process simulations (Christopher, 2002). These are discussed in detail in the following section.

2.4.2.1 Tactical Decision Simulation

In a tactical decision simulation, the focus is on the learner to use his/her skills to interpret information and create a solution to the presented problem (Gredler, 1994). It enables users to interact with complex problems, use their skills to interpret data, execute their respective roles, organise their findings and test their solutions without danger. Early examples of tactical decision simulations include war games and MIT's SimCity application.

2.4.2.2 Social Process Simulation

In social-process simulations, the emphasis is on the study of human interactions and communication in pursuing social or political goals. In such simulations, "*participants assume individual roles in a hypothesised social group and experience the complexity of establishing and implementing particular goals within the fabric established by the system*" (Christopher, 2002). Basically, it suggests that participants must attempt to function as members of a group, undertake frustrating or traumatic tasks and endeavour to function in the negative conditions. One such example would be to blindfold a participant so he or she could experience a sightless world.

2.4.3 Categories of Computer Simulations

According to Alessi and Trollip (1991), there are two classifications of simulations: one that *teach you about something* and those that *teach you how to do something* (see *figure 2-3*). Within these two classifications encompass the four main computer simulation categories. They are: -

- Physical - representation of a physical object or an array of objects is displayed on the computer screen, allowing users the opportunity to manipulate it to better understand its behaviour.
- Procedural - designed to showcase a sequence of events or/and actions. These simulations typically react to input and provide feedback to the user.
- Situational - simulations that involve attitudes and behaviours allowing users to experience different roles in a wide range of scenarios.
- Process - typically a one-way simulation where a user defines the settings at the beginning of the simulation and evaluates the process as it is performed without any input.

It is not uncommon for computer simulation systems to overlap in some categories and have the capacity to fulfil functions from various categories described above. As simulators are further developed, it can maintain its original characteristics and newly added ones as well.

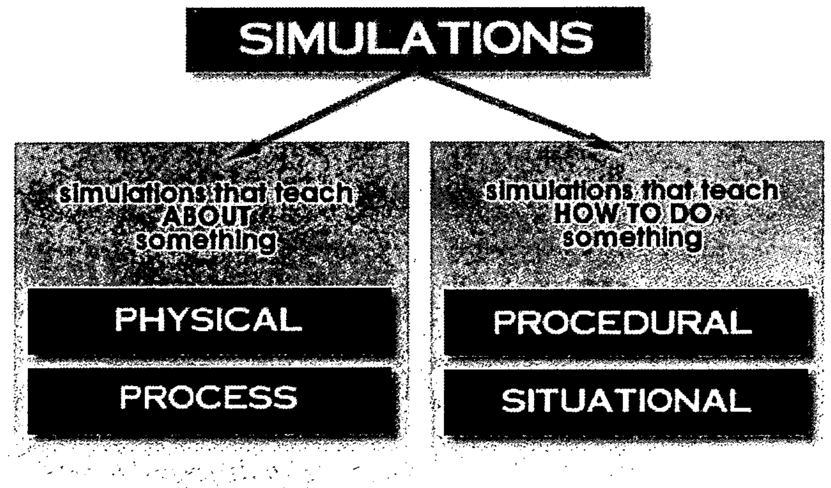

Figure 2-3 Simulation Classification
(Source: McNeil, 2003)

2.5 Learning Theory

This section examines common learning theories, learning styles and models that describes how learning occurs or are influenced in learners. These areas underline many of the existing methodologies used for both teaching and learning, and so it is important to understand its role in the process of student learning. Also, it will include a discussion on the emergence of learning objects that has opened up new opportunities for the management and delivery of instructional material.

2.5.1 Learning Approach

Education institutions and training organisations are often criticised for providing little information with practical application to the real world (Bill, 1997). Rogers (1969) differentiated between two types of learning: *cognitive*, which is depicted as meaningless and ineffective, and *experiential*, labelled as significant. Cognitive thinking is referred by Rogers as content that is delivered to learners in the name of knowledge. Whitehead (1929) also referred to this as *inert knowledge* in some of his works. Nonetheless, both authors conclude with similar views that knowledge has very little use unless it can be applied or associated with real world applications.

Rogers firmly believes experiential learning or knowledge, which is gained through the discovery of new information during the application of prior knowledge, as significant, and an area of teaching where high emphasis must be placed. The justification is that experimental learning is typically initiated by the individual out of necessity, thus, relevancy to the learner's reality is established immediately (Rogers, 1969; Bill, 1997).

Another critical component of experiential learning is the personalisation of the nature of the experience. It allows individuals to place abstract concepts into context by providing an environment where prior knowledge must be recalled (Bill, 1997). This also intersects with *constructivist theory*, where individuals draw upon prior knowledge or experiences to construct or form new schema, and results in a foundation for active discovery learning (Keys and Wolfe, 1990). Furthermore, Keys and Wolfe identified three essential elements to effective simulation instruction as shown in *table 2-2*:

Element	Details
Content	The dissemination of new ideas, concepts and principles.
Experience	An opportunity to apply content previously given.
Response	Obtain feedback based upon the reactions of the learner.

Table 2-2 Effective Simulation Instruction
(Source: Keys and Wolfe, 1990)

In addition, Keys and Wolfe commented on the benefits of computer-based simulation, the added bonus of multimedia technology has given instructional designers the tools of animation, video and sound to provide learners with working models that convey complex concepts.

2.5.2 Learning Styles

Each learner is an individual with his or her own motivation for studying, study habits and practises. 'JIT' (or Just in Time) and 'Just for Me' education are some of the many proposed methods of meeting the needs of today's learners, and more importantly, the shift towards the focus upon personalisation of content and teaching (Cornelius, 2000). Educators need to better understand who their learners are and how they learn.

Empirical research have identified that a diverse group of learners can be characterised by their learning style. By classifying learners, individuals themselves can increase retention of the subject matter, which typically results in positive learning outcomes (Zuber-Skerritt, 1992). Keefe (1987) believes in the importance of delivering learning to students that conforms with an array of learning styles. He describes learning styles as: -

> *"....the characteristic cognitive, affective and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment....Learning style is a consistent way of functioning, that reflects underlying causes of behaviour"*

Although numerous authors have attempted to classify learning styles for adult learners, only a distinct few have been embraced by the academia community. David Kolb is one of the few as he provides a firm theoretical base, which is lacking in the work of many other writers (Holman, Pavlica et al., 1997). Kolb (1994) identified four learning modes (see *figure 2-4*) which is widely adopted for the classification of learning styles and is based on experiential theory: -

- Active - learning through concrete experience. Typically learn by trial and error.
- Reflective - learning through reflective observation. Often adopt a 'wait and see' approach.
- Experimental - learning through active experimentation. A category of learners that seek to find new ways and techniques of achieving objectives.
- Theorising - learning through abstract conceptualisation.

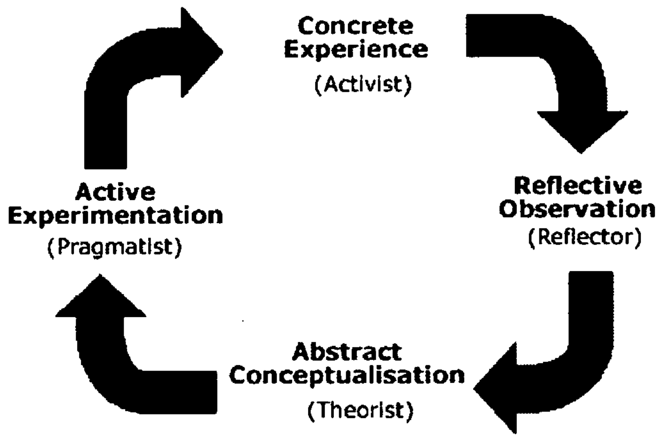

Figure 2-4 Honey and Mumford: Typology of Learners

However, the classification of learning styles is not perfect and, as stressed by Lockitt (1997), there is no single learning style that will be perfect for every individual since human beings are complex and continuously changing with new experiences, information and knowledge. He referred to research done by Honey and Mumford (1992) which revealed that different, individual learning styles affects the way that you accept and assimilate information.

2.5.3 Early Learning Models

A number of different theoretical approaches to learning exist in the formation of teaching practises. These range from instructivist, tutor-centric classroom approaches to student-centred discovery learning involving action and interaction (Cornelius, 2000). The most common and most widely adopted learning models in higher education include *constructivist learning, collaborative learning, experiential learning,* and *problem based learning*. It should be noted that the learning models are not mutually exclusive (Montgomery, 1995). For example, it is not uncommon to discover that constructivist and collaborative learning to work well together.

Constructivist Learning

The constructivist approach to teaching (and learning) is based on the premise that cognition (learning) is the result of "*mental construction*" (Valdez, McNabb et al., 2001). In most cases, the focus is on the learner's construction of knowledge and understanding through appropriate activities (Cornelius, 2000). Constructivists believe in the importance of the context in how ideas and material is taught, and also the individual's beliefs and attitudes.

Collaborative Learning

Learning through collaboration is initiated as a result of aiming for common objectives, the sharing of a common body of knowledge and interaction with peers (Cornelius, 2000). It provides opportunities for individuals to participate in cross-cultural group dynamics; to articulate, explicate, and defend their ideas and hidden motives; and to manage their work flow amid a high degree of uncertainty about how a task should be done (Hamada and Scott, 2001).

Experiential Learning

Experiential learning, the gaining of knowledge and learning through experience, is particularly applicable to adult learners, many of whom appreciate the close association with the real-world (Laurillard, 1994). According to Bowden (1987), experiential learning has maximum influence when it is: accompanied by emotional arousal; takes place within a safe environment; and gives adequate processing time with clear summary providing a cognitive map of the experience. The first two factors are of distinct interest to simulation designers (Bill, 1997). As Bill mentions, computer simulators, in contrast to the classroom, provide the learner with performance feedback in private, thus, enhancing the opportunity for exploration without peer pressure or public humiliation. Often, this is a concern with adult learners who fear failure.

Problem Based Learning

Problem based learning is a pedagogical strategy for "*...posing significant, contextualised, real world situations, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills*" (Mayo, Donnelly et al., 1993). In this learning model, the direct amount of instruction is reduced, and students are given greater autonomy and responsibility for their own learning (Bridges and Hallinger, 1991; Jones, 1996). Jones perceived that acquiring the ability to solve problems is more than just accumulating knowledge and rules, it is the flexible and cognitive strategies that help analyse unanticipated, ill-structured problems to produce relevant and meaningful solutions.

2.5.4 Learning Objects

Learning objects are modular digital resources, uniquely identified and meta-tagged, which can be used in technology supported learning (Wiley, 2000). According to the National Learning Infrastructure Initiative (2003), they include but are not limited to, "*simulations, electronic calculators, animations, tutorials, text entries, web sites, bibliographies, audio and video clips, quizzes, photographs, illustrations, diagrams, graphs, maps, charts and assessments*". The primary objective of learning objects is to transform how educational content is managed and delivered by breaking it down into small, encapsulated pieces that can hopefully be reused in various learning environments (Wiley, 2000). This concept is grounded in the objecte oriented paradigm of computer science, where programmers create objects that can be reused to ensure code duplication and costs minimisation.

Unlike other instructional teaching (and learning) methods, where teachers gather material and structure it into their constituent parts (Wiley, 2000), learning objects can be used to avoid this tedious process. This not only save course development costs, enhance sharing knowledge within and across disciplines and provide a firm base for improving learning objects, but also provide learners with standardise materials ensuring variations between institutions are minimised. Furthermore, from the students' perspective, it will offer *"...learning customized for each specific learner at a specific time, taking into account, their learning styles, experience, knowledge and learning goals*" (Schatz, 2000).

Governments are already putting significant amount of investment in initiatives to further develop learning objects and learning object repositories to increase its appeal and adoption by educators. Examples include the *Curriculum Online* project being undertaken for schools in the UK at a cost of approximately $500 million and the *Australian Learning Federation*, a project similar in emphasis, with a $30 million budget (Friesen, 2003). Also, there are projects being currently undertaken in Canada (i.e. eduSource, 2003; SchoolNet, 2003), the US (i.e. HEAL, 2003; iLumina, 2003), and by regional and international consortia (i.e. EducaNext, 2003). Furthermore, the Learning Technology Standards Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE) was formed in 1996 to promote and develop instructional technology standards (Wiley, 2000). Thus, there is a considerable push to make learning objects play a key role in the future of instructional learning and delivery. However, there are inherent dangers that arise from this push. Friesen (2003) believes that for e-learning standardisation and infrastructure efforts to be realised, greater attention needs to be given to current educational practises, issues surrounding innovation adoption and on the heterogeneity of educational activities and contexts in general. He cites that:

> "*To properly deal with this divergence and complexity -- and with issues also now emerging from training and other communities -- it is necessary to look beyond systems engineering techniques and standardization processes. These techniques and processes may work well for more exclusively technical applications, but they are proving inadequate for dealing with the ambiguities implied in education and even in the deceptively simple term "learning*"."

2.6 Engaged Learning

The fundamental concept underlying engaged learning is that students must be fully engaged in learning activities through interaction with others and undertake meaningful tasks. While this is possible without the utilisation of technology, it can increase the capabilities of facilitating engagement in ways which are difficult to achieve otherwise (Papert, 2003), especially, when it involves complex or ill-structured activities. Thus, engagement theory is intended to be a conceptual framework for technology-based teaching and learning.

Engaged learning is different from many older models of computer-based learning, which focused on individualised instruction and interactivity (Kearsley and Shneiderman, 1999), rather than promoting human interaction in the context of group activities, and not just emphasis on individual interaction with an instructional program. Another key difference between engaged learning and the older models is the perception of technology as a communication and learning tool instead of some form of delivery device only (Kearsley and Shneiderman, 1999). In addition, there is significant focus on providing a meaningful setting for learning, not present in previous models.

Two primary weaknesses in the present literature regarding engaged learning facilitated by technology is concerning the primary focus on primary and secondary education levels, and the study of limited technologies. The engaged learning findings from primary and secondary education levels is difficult to generalise to other age groups (for example, Alavi, 1994; Hiltz, 1994), such as, higher education or adult learners because mature students have different needs and have more experience that influenced the style of learning required for them to perform (Kolb, 1994; Alberta, 2003). Secondly, the study of engaged learning have often been limited to technologies including the use of email, online conferencing, web databases, groupware and audio/videoconferencing, as opposed to advanced, computer simulators that is immersive, and offers the opportunity to both learn and assess their own performance. As such, engaged learning, or even engagement theory, has not been subjected to empirical tests, and so tenet of the theory needs to be investigated and examined via research or evaluation studies (Kearsley and Shneiderman, 1999).

2.6.1 Definition

The definition for engaged learning is constantly evolving, which is a typical reflection of the changing methods and strategies employed to enrich and engage the learning experience of students. Since engaged learning is subjective and contains differing meanings to individuals, current literature has numerous definitions for engaged learning. Below are two common definitions:

> "*Engaged learning describes the learning environment and instructional strategies that support students in constructing knowledge in meaningful ways that allow students to establish their own goals, explore appropriate resources and work together in groups to research real life issues which are meaningful to them, multidisciplinary in nature, and in which teachers serve as guides, coaches, facilitators and co-learners* (Leonard, 2000)."

> "*Engaged learning means there is an active involvement and commitment in the learning process. A definition of engaged learning can be as personal as your own teaching style and strongly reflects the intentions of the Engaged Learning Indicators* (Buchler, 2001)."

For this research, we will adopt Leonard's definition of engaged learning as the researcher believes it to capture the underlying meaning.

2.6.2 Engaged Learner Indicators

Researchers have in recent years formed a strong consensus on the significance of engaged learning in schools and classrooms. This coupled with the recognition of the changing user learning processes of the 21st century has led to the development of engaged learning indicators. These eight indicators are *vision of engaged learning, tasks for engaged learning, assessment of engaged learning, instructional models and strategies for engaged learning, learning context of engaged learning, grouping for engaged learning, teacher roles for engaged learning* and *student roles for engaged learning* (Jones, Valdez et al., 1994). Each of these indicators is described in detail in *table 2-3*: -

Variable	Indicator	Definition
Visions of Learning	Responsible learning	Learner involved in setting goals, choosing tasks, developing assessments and standards for the tasks; has big picture of learning and next steps in mind.
	Strategic	Learner actively develops repertoire of thinking/learning strategies.
	Energized by learning	Learner is not dependent on rewards from others; has a passion for learning.
	Collaborative	Learner develops new ideas and understanding in conversations and work with others.
Tasks	Authentic	Pertains to real world, may be addressed to personal interest.
	Challenging	Difficult enough to be interesting but not totally frustrating usually sustained.
	Multidisciplinary	Involves integrating disciplines to solve problems and address issues.
Assessment	Performance-based	Involving a performance or demonstration, usually for a real audience and useful purpose.
	Generative	Assessments having meaning for learner; maybe produce information, product, service.
	Seamless and ongoing	Assessment is part of instruction and vice versa; students learn during assessment.
	Equitable	Assessment is culture fair.
Instructional Model	Interactive	Teacher or technology program responsive to student needs and requests (e.g., menu driven).
	Generative	Instruction oriented to constructing meaning, providing meaningful activities/experiences.
Learning Context	Collaborative	Instruction conceptualizes students as part of learning community; activities are collaborative.

Grouping	Knowledge-building	Learning experiences set up to bring multiple perspectives to solve problems such that each perspective contributes to shared understanding for all; goes beyond brainstorming.
	Empathetic	Learning environment and experiences set up for valuing diversity, multiple perspectives, and strengths.
	Heterogeneous	Small groups with persons from different ability levels and backgrounds.
	Equitable	Small groups organized so that over time all students have challenging learning tasks/experiences.
	Flexible	Different groups organized for different instructional purposes so each person is a member of different groups; works with different people.
Teacher Roles	Facilitator	Engages in negotiation, stimulates and monitors discussion and project work but does not control.
	Guide	Helps students to construct their own meaning by modelling, mediating, explaining when needed, redirecting focus, providing options.
	Co-learner/co-investigator	Teacher considers self as learner; willing to take risks to explore areas outside his/her expertise; collaborates with other teachers and practicing professionals.
Student Roles	Explorer	Students have opportunities to explore new ideas/tools; push the envelope in ideas and research.
	Cognitive Apprentice	Learning is situated in relationship with mentor who coaches students to develop ideas and skills that stimulate the role of practicing professionals (i.e., engage in real research).
	Teacher	Students are encouraged to teach others in formal and informal contexts.
	Producer	Students develop products of real use to themselves and others.

Table 2-3 Engaged Learning Indicators

(Source: Jones, Valdez et al., 1994)

2.6.3 Impact on Learning and Teaching

In a technology-based, engaged learning environment, teachers have a less direct role in regulating the learning of students, but rather facilitate learning in a number of roles including guides and co-learners (Jones, Valdez et al., 1994), and become designers of learning opportunities. They are involved in activities, such as, adjusting the level of information and support according to the student's needs, refocus student efforts when required, help students link new information to prior knowledge and become producers in a knowledge-building community.

For students, engaged learning encourages them to be explorers and cognitive apprentices where they focus on discovering concepts, connections and apply skills by interacting with the physical world, materials, technology and other people (Jones, Valdez et al., 1994). They also become reflective and critical thinkers where they refine their thinking processes to formulate more questions, problems and solutions. Thus, they can ultimately not only construct new knowledge through synthesis of prior knowledge, experience and skills for themselves but also contribute to the world's knowledge (Jones, Valdez et al., 1994).

The problem with past and present traditional teaching and learning methods is that it has not been effective in seizing and maintaining the attention of learners, often relegating them to a passive role. This is contrary to studies where learning is found to be much more effective when it is an active discovery process. According to a 1998 Chicago Public School Pilot study of virtual reality (which shares some common characteristics with computer-based simulations), Sykes and Reid report that:

> "*Using virtual reality in the programs was an effective response to pressing educational needs. First and foremost, students, especially at-risk students, must become more involved with their studies. To many students today, school is boring.*"

2.6.3.1 At-risk Students

Technology-based facilitation of engaged learning has been identified to have the potential to profoundly influence the education of students, particularly, at-risk ones. At-risk students are assumed not to have the capacity to learn sophisticated ideas, and often labelled as underachievers (Papert, 2003). Papert believes technology-based learning to inspire "*...greater performance in at-risk students, of which the status quo and scores of other learning methodologies have previously failed*". These at-risk students are commonly better served by teaching styles that are more visual and experimental, and which increases their comprehension of information (Leonard, 2000).

2.6.3.2 Teaching Perspectives

Similarly, new teaching methods and technologies used to underpin engaged learning have relieved teachers and educators of the growing work burden by today's classroom and its changing role in society. From a teacher's perspective, computer-based simulators and engaged learning creates a safe environment that focuses students on specific learning goals. Also, using an engaged approach to learning greatly heightens the relevance of material compared to traditional teaching techniques, such as, student classroom participation and reading textbooks.

2.7 Value of Technology

The value and impact of technology in education for both teachers and learners continues to be debated, even as computer-based technology is recognised as a key factor in the increase of work productivity and economic success of the United Stated, particularly, during the 1990s. So far, research on technology's effectiveness and educational uses is sparse and, in some cases, disappointing in quality (Valdez, McNabb et al., 2000). However, the authors identified the difficulty in studying the technology's impact on learning is that it has been a moving target due to rapid developments and innovations. As a result, some findings are obsolete before they are even published.

Nonetheless, a study by Jones, Valdez, Nowakowski, & Rasmussen (1994) is one of the few rare ones to offer a strong theoretical base detailing the relationship between the effectiveness of technology and engaged learning. The authors determined technology effectiveness can be defined as the intersection of two continuums (see *figure 2-5*).

Category A: Engaged learning and high technology performance

Category B: Engaged learning and low technology performance

Category C: Passive learning and high technology performance

Category D: Passive learning and low technology performance

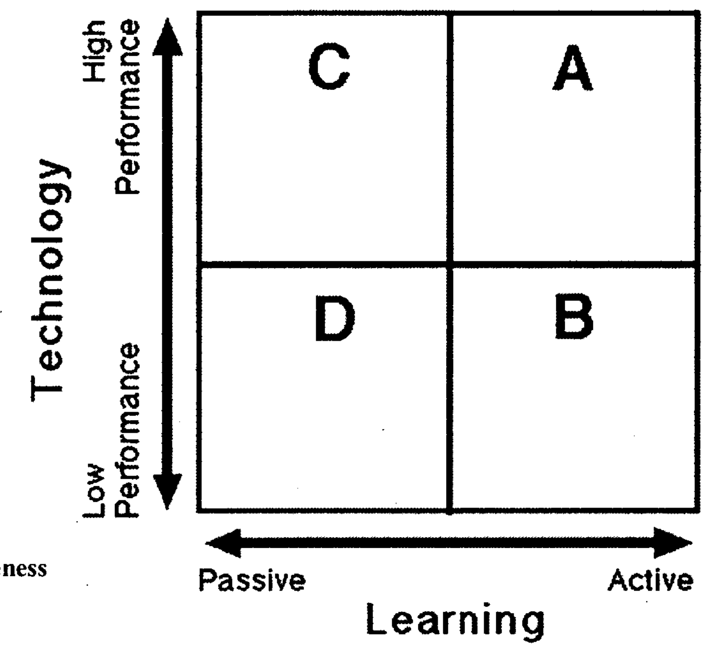

Figure 2-5 Technology and Learning Effectiveness
(Source: Jones, Valdez et al., 1994)

As indicated in the diagram, one continuum describes learning (the horizontal arrow) which shows incremental progress from passive to engaged (and sustained) learning. The other continuum describes technology performance (the vertical arrow), which illustrates incremental progress from low to high performance. Although the study was primarily based upon data from secondary schools and their exposure to a small number of technologies including e-mail, computer driven software and approaches, integrated learning systems and distance education technologies, it gives exceptional insight into how students adapt to technology and engaged them in their everyday work activities (Jones, Valdez et al., 1994). They concluded with the recommendation that education institutions, especially secondary levels, should focus their vision for using technology in category A and B (*see figure 2-5*).

Benefits

There have been a number of studies that have reflected a positive outcome on the adoption of computer-based technology in learning. Several student-based studies have found that students identified as "at-risk" show dramatic improvements in academic achievement after the introduction of technology into the classroom (Fuchs, Fuchs et al., 1991; Griffin, 1991). For example, Fuchs, Fuchs et al. highlighted the study conducted by Sinatra, Beaudry, Pizzo, and Geisert (1994) that investigated the effect of integrated systems on the achievement of fourth-grade students with reading disabilities, which indicated significant increase in test scores. The research consisted of approximately 260 students selected from six urban elementary schools who had scored below the 25th percentile on standardised reading tests. Furthermore, the value and benefit of technology on learning is best summed up by Turrof (1995) by saying that: -

> *"Once we free ourselves from the mental limits of viewing technology as a weak sister to face-to-face synchronous education, the potentials to revolutionize education and learning become readily apparent."*

Regarding the adoption of technology as a learning tool, several studies have demonstrated its success, and its impact on how they teach (see *figure 2-6*) compared to traditional methods (for example, Ng, Chong et al., 2001; McNeil, 2003; Usun, 2003). For example, the *Software Publishers Association* (SPA) in the United States commissioned an independent meta-analysis of 176 studies focusing on the effectiveness of technology in schools. It concluded that the use of technology as a learning tool can make a dramatic contribution to student achievement as measured by standardised tests (Sivin-Kachela and Bialo, 1993). It identified positive outcomes in all major subject areas, in preschool through to higher education and for both regular and special needs education.

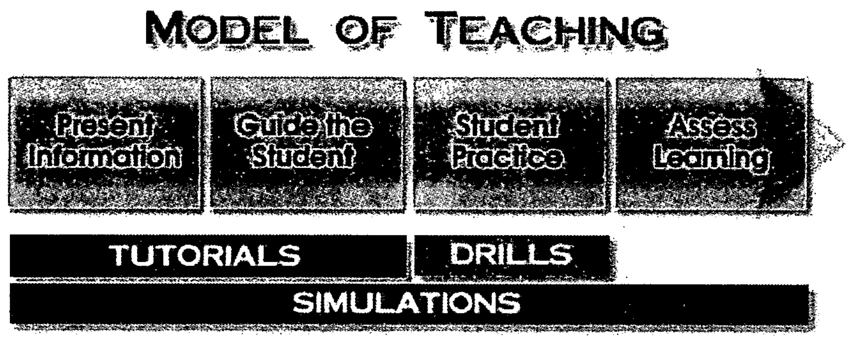

Figure 2-6 Model of Teaching
(Source: McNeil, 2003)

2.7.1 Limitations

According to a majority of opinions in present literature, computer and computer-assisted instruction is adopted because of the benefits they offer to learners including the potential to eliminate some barriers to participation, address some of the unique needs of adult learners, and as a support tool to meet the increasing demands of adult education (Usun, 2003). But technology may not always suit the learner's characteristics and learning style.

2.8 Computer-based Simulators and Engaged Learning

Advanced, full scale computer simulators differ from other typical computer-based learning in that it places the student in a simulated environment that looks and feels like the real world, and replicates not just through the virtual environment, but also the physical one i.e. controls, displays and triggers. Hence, as Papert (2003) explains that:

> *"It allows students to create their own experiences, the type of knowledge that has so far been possible only through direct experience with the world, never through computer interfaces or any of the third-person experiences that predominate in school."*

It also puts the learner inside the subject and he or she can become a part of what they are learning. As a result, it can create an effective setting to engage the student to take up an active role in their learning process and allow them to approach the problem through self-guided discovery and experimentation, which typically results in the construction of new knowledge and concepts. Thus, computer-based simulation is an excellent candidate to provide an ideal environment to foster engaged learning, which is also evident in the studies and research outlined below.

The Human Interface Lab at the University of Washington reports that technology, such as, virtual reality have shown that students are capable of learning curriculum content by interacting with virtual objects and that they achieve higher learning outcomes in an interactive environment than non-interactive ones. They conclude that results suggest that learning in an immersive virtual reality environment leads to better conceptual understanding of subjects (as compared to the recall of factual knowledge) than other traditional methods. Although virtual reality technology differs to computer simulators, new generation of advanced, full scale simulators attempts to simulate both a virtual and physical environment to provide a realistic experience as possible.

A quantitative study by Lunde (2001) into the ship handling facilities at *The Royal Norwegian Navy Navigation Center* offered insight into the effectiveness of its Navy simulators. Lunde's findings showed that:

- 93% says realism related to real life was satisfactory or better
- 78% are more relaxed in the simulator compared to real life navigation
- 92% felt able to use the same navigation principles as onboard
- 86% claims ship handling realism to be average or better

The study also indicated that the simulators are great assets to supplement real life navigation but cannot replace it (Lunde, 2001). This seems to reinforce current evidence in the present literature that simulators are great tools but cannot ultimately replace the real life experience. However, his research did not cover issues, such as, the participants' learning process and outcomes, and the influence of the simulator on the individuals' learning that the researcher believes to be more worthwhile.

Andresen and Ahdell's (2001) Master of Science dissertation, *Games and Simulation in workplace eLearning*, published by the Norwegian University of Science and Technology discussed the importance of engaged learning. They cite that "*...engagement is a condition for effective learning and that it deserves more attention*", and identified six factors for engagement: interactivity, flexibility, competition, reality, drama effects and usability. However, their research was focused on both games and simulations, and the findings were derived from end-users, content designers, and company management. The authors failed to discuss in-depth in how these factors relate to each other, and placed too much emphasis on describing how to create an effective eLearning product in the marketplace.

2.8.1 Areas of Research Weakness

Computer-based simulation technologies and applications are not new, and have been available for over six decades. However, there are still important issues, or according to Neuman(200) "*blind alleys*" which requires further investigation. These areas are outlined below and will need to be addressed so that more effective and engaging learning outcomes can be achieved.

Combination of passive and active learning methods coupled with technology

An area where further research may be applied is the focus on the combination of passive and active learning instructional methods, coupled with technology, in facilitating the education of student learners. The current literature has suggested that both passive and active instructional methods have merits and disadvantages under differing circumstances and learning environments (Mills-Jones, 1999), and would be invaluable to Governments, commercial enterprises and interested parties to better understand the impact of technology on learners, especially, on different age and social groups. In most situations, schools and other education facilities could adopt both types of methods, since not all content is appropriate for one or the other. A majority of the literature has more emphasis on distinguishing the characteristics, framework, limitations and learning outcomes from the two methods; rather than to try and understand how both passive and active learning methods can be incorporated into, or affect, student learning.

Also, upon reflection of the real-world, it is important to note that education institutions and other training facilities will not adopt changes overnight because of the complexities involved i.e. retraining of teachers, additional resources to purchase technology. So, there is significant value in understanding the synergy of student acceptance and value, supporting both forms of learning, particularly in cases where there is a slow transference from passive to active learning environments or the requirement of both.

Focus on higher education or adult learning

According to Gokhale (1995), there is a general neglect on the focus of engaged learning and support of technology in other levels of learning outside primary and secondary levels. As a typical learner evolves, different approaches to teaching are required to meet his or her needs, and as such, findings from primary or secondary levels may not be generalised beyond that age group or that learning context. Also, studies show adult learners are more self guided in their learning, have greater learning expectations and seek education that "make sense" (RIT, 2000), which cast further doubts about the legitimacy of findings being applicable to adult learners. Below are the results from one of those studies (see *table 2-4*):

Learner Characteristics	
Adult Learner	**Youth Learner**
Problem-centred; seek educational solutions to where they are compared to where they want to be in life	Subject-oriented; seek to successfully complete each course, regardless of how course relates to their own goals
Results-oriented; have specific results in mind for education - will drop out if education does not lead to those results because their participation is usually voluntary	Future-oriented; youth education is often a mandatory or an expected activity in a youth's life and designed for the youth's future
Self-directed; typically not dependent on others for direction	Often depend on adults for direction
Often sceptical about new information; prefer to try it out before accepting it	Likely to accept new information without trying it out or seriously questioning it
Seek education that relates or applies directly to their perceived needs, that is timely and appropriate for their current lives	Seek education that prepares them for an often unclear future; accept postponed application of what is being learned
Accept responsibility for their own learning if learning is perceived as timely and appropriate	Depend on others to design their learning; reluctant to accept responsibility for their own learning

Table 2-4 Adult versus Youth Learner

(Source: Rochester Institute of Technology, 2000)

A Firm Theoretical Framework

It is important to develop more firm theoretical frameworks to offer educators a foundation to establish policies that hopefully encourage the adoption of engaged learning. Also, theory enables other researchers to build upon the work of others, and provide a general guide to acquire further answers and knowledge to questions in this field. In contributing to the body of knowledge or literature ensures that theories can evolve and adapt to the changes brought on by influences such as student expectations and developments in technology.

2.9 Profile of AMC' Ship-handling Simulator

The Australian Maritime College in Launceston is home to its Integrated Marine Simulator (IMS). The IMS is used to house its main maritime training operations with six 'own-ship' cubicles - each with 120 degree visuals - and its ship handling simulator with a full-scale bridge and 202.5 degree visuals. The focus of this study will be based on its full-scale ship handling simulator.

The ship handling simulator is one of the most advanced simulators of its type in the world, and is powered by the *Krupp Atlas Ship Handling Software*. Its full-scale bridge is a physical replication in the attempt to create a realistic environment and stated in the 2002 AMC handbook as "*...invaluable for research and investigation into port development, ship manoeuvring, and improving ship and port safety and efficiency.*"

Currently the ship handling simulator has:-

- Over 30 Australian and International area models
- Over 40 ship models ranging from a 2,000 dwt Rig Tender to a 340,000 dwt VLCC

It offers ports and exercise areas with full day/night visual scenery, and incorporates environment variables such as current velocity, wind speed and sea state direction to ensure real-world association. The ship handling simulator (or the IMS) is accessible for both student training and industry customers.

2.10 Chapter Summary

This chapter outlined a number of studies and research programs conducted in this field of interest and discussed the major findings (and weaknesses). Its purpose is to build a familiarity with a body of knowledge and establish credibility (Neuman, 2000:446). It covered issues including different learning models and styles, evolution of computer simulators, engaged learning indicators and the impact of technology in student learning.

Chapter Three

Methodology

"Personally, I'm always ready to learn, although I don't always like being taught."
Sir Winston Churchill (1874-1965)

3.0 Chapter Three – Methodology

3.1 Chapter Introduction

This chapter presents the type of research methodology used in this study. It will include a discussion of the chosen research ontology and epistemology. Also, the distinction between qualitative and quantitative research is addressed to determine which method is most appropriate for this exploratory study. Through this examination, the researcher's epistemological, ontological and methodological stance will be justified.

The methods employed to collect the data and the mode of data analysis will be outlined in detail as well. Finally, validity is an important aspect of this study and so this chapter will explain how validity was obtained.

3.2 Ontology

Ontology is a theory of being or existence of entities and relationships (Liao, 2002). It is essentially concerned with the stance on the beliefs about reality. Each special science or field has its own ontology (i.e. people, institutions, norms, practices, structures, roles, and etc) and contain assumptions about what kinds of things do or can exist in a domain, including conditions for existence and so forth (Denzin and Lincoln, 2000). Thus, each researcher's philosophy or approach defines reality differently and so have consequences to the construction and outcomes of their research program.

There are two positions on the beliefs about reality: *subjectivity* and *objectivity* (Neuman, 2000).

3.2.1 Subjectivity

The subjective stance believes the world of tangibles only exists through the actions of humans, and so the researcher is intimately involved. The researcher cannot be detached from the phenomenon being investigated because the viewpoints and past experiences of the researcher affect the study, and therefore, it puts the researcher into the context of the situation to understand it (Olson, 1995). Denzin and Lincoln (1994) also notes that "*any gaze is filtered through the lens of language, gender, social class, race and ethnicity*"

According to Garcia and Quek (1997), "*objectivity in social sciences assumes a meaning only in relation to a subjective domain which confirms and supports the claim of an objective reality*". As such, this is criticised by qualitative researchers in the field of information systems because the objective or scientific method assumes away much of the 'richness' and 'complexity' of information systems, and often the context in which the phenomena is captured. Thus, a subjective ontology can in many ways fill this gap. A researcher's subjectivity allows the penetration of the fronts of individuals and groups that permits deeper understanding of the actors' perspectives and ways of living (Garcia and Quek 1997).

Subjectivity may guide the researcher from the choice of topic interests, to the formulation of hypothesis, to selecting methodologies, and how to interpret data (Ratner, 2002). Furthermore, subjective research often seeks to understand the phenomenon through the eyes of the respondents.

3.2.2 Objectivity

In contrast, the objective stance believes the world of tangible things exit unperceived and independent of humans. Objective researchers made every attempt to eliminate bias while subjective researchers recognise, and acknowledge it – perceiving it as strength rather than a problem (Mellon, 1990; Olson, 1995). Mellon (1990:26) also states that: -

> *"...total objectivity is impossible for researchers who are, after all, human beings. The difference between the two research traditions is not that one has and one lacks objectivity. The difference is that naturalistic researchers systematically acknowledge and document their biases rather than striving to rise above them".*

According to Neuman, the objective stance is founded on three main beliefs: -

- Data gathered from research on the phenomena must be free of non-random errors and unbiased in nature to ensure validity. As such, the researcher must be detached of their personal opinion, only accept supported views about the phenomenon, and data gathering techniques must be transparent and technical correctness must be assured.

- Observation of the tangible phenomena should be viewed from an external, factual precise and logical manner. The researcher must adopt a logical mindset in investigating the phenomena, and approach it without any personal preconceived opinions in the direction of the research.

- The researcher's personal prejudices and cultural values must be isolated from the phenomena to ensure free and neutral observations to be conducted.

3.2.3 Research Ontology

This research aims to gain insight and understanding into the perceptions of AMC's ship-handing simulator users regarding engaged learning and their experiences with the simulator. It seeks to understand thoughts, beliefs and concepts held by individual participants, and also to construct group-based perceptions from these individual perceptions. So it is essential for the researcher to become familiar with the perceptions of the participating simulator users. This approach requires an interpretive epistemology as it is considered the most appropriate, based upon a subjective ontology, since it is concerned with the realities of learning and seeks to gain a deep understanding of the selected participants' perceptions of engaged learning.

3.3 Epistemology

Epistemology is the branch of philosophy dealing with the origin, nature and limits of human knowledge, or of how we come to understand the various ways of learning and knowing. Thus, it can be perceived as beliefs and presuppositions that influence how knowledge is formed and attained (Orilikowski and Baroudi, 1991; Neuman, 2000). As Orilikowski and Baroudi explains; these beliefs and presuppositions affect the means in how one understands the world and shares this knowledge with others.

The three major epistemological positions (see *figure 3-1*) are *interpretivism, positivism* and *critical social science*. Each position has a different perspective of the world, and assumptions regarding how the study of a social phenomenon should be approached. Furthermore, these three types of epistemologies may be philosophically distinct in an idealistic world, but in practise the distinction is not always easily defined (Myers, 1997). Nonetheless, these different philosophical values and assumptions offer information systems research added richness and variety in how to understand and obtain knowledge regarding information systems phenomena.

The three main epistemological positions in information systems research are discussed below.

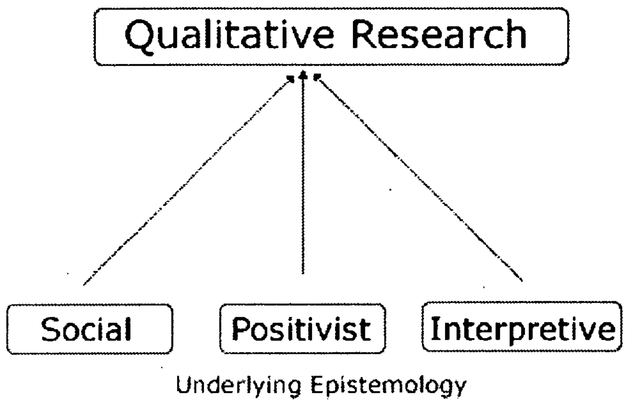

Figure 3-1 Qualitative Research Epistemology

(Source: Myers, 1997)

3.3.1 Positivism

Positivism is based on natural science and which theories and hypothesis are tested and verified or falsified. This approach is characterised by neutrality and objectivity where every attempt is made to avoid personal bias. Therefore, the social world exists independently of the observer and is made up of discrete objects and events (Gubbay, 2003).

Positivist commonly assumes that science is a vehicle to attain truth, to understand it enough so it can control and predict it. They assume the world is deterministic, and attempts to discover laws of cause and effect that govern this rational world (Trochim, 2002). Furthermore, positivists try to discern patterns in human behaviour, and interventions that affect human behaviour. It is achieved by hypothesising variables and relationships amongst them, operationalised into the measurable phenomena, and so measurements can be standardised as precisely as possible (Sleeter, 2003). Thus, the main purpose is to generalise or construct universal truths that guide the selection of interventions.

3.3.2 Interpretivism

Interpretivists often criticise the positivist approach as lacking everyday subjective interpretations or context. It commonly involves the adoption of procedures, modelled on the natural sciences i.e. experiments and surveys for testing theories against observed facts, and is often employed in quantitative research.

Interpretivism is based on how humans interpret and make sense of reality. It is based on the principle that science is subjective, and so allows other alternative representations of reality. This is a direct opposite to the views held by positivists where science must be objective, by claiming that all observations are affected by a large array of issues, such as, personal viewpoints and past experiences of the researcher (Darke and Shanks, 1997). Interpretive theory involves building theory based upon other peoples' theories in contrast to positivism, which is concerned with objective reality and meanings independent of people (Gephart, 1999).

Interpretivist researchers recognise that language (and semantics) may have different meanings to different people, and so it is important to thoroughly investigate and understand the phenomena before insightful knowledge can be attained (Heinz and Myers, 1999). Also, the interpretivist wants to know why things are happening, in a particular society and an understanding of how it operates, by investigating the individuals' attitudes, outlooks, opinions, behaviour and understanding attached to the phenomena under study (Heinz and Myers, 1999). Researchers approach participants not as individuals who exist in a vacuum but within the context of their lives.

Consequently, the outcomes of interpretive research are often not repeatable or generally applicable to a wider range of situations. Nevertheless, the results are significant and have implications for the scenario and its participants, and can be useful in other situations where there are close resemblances to the original research (Heinz and Myers, 1999)

3.3.3 Critical Social Science

Critical Social Science (CSS) holds the underlying assumptions and beliefs that human beings are able to critically assess and change society and also become emancipated (Gittins, 2001). This approach is strongly influenced by values, judgements and interests of humankind.

CSS researchers support and agree with a majority of the criticisms the interpretive approach directs at positivism but includes some of its own and disagrees with ISS on certain areas (Neuman, 2000: 76). As Neuman explains that "*critical social science criticized posivitist science as being too narrow, antidemocratic and nonhumanist in its use of reason*". Furthermore, CSS researchers criticise interpretivism as being too concerned with being subjective reality for being too passive and amoral and placing too much emphasis on peoples' ideas as being more important than the actual settings and so neglect the broader, long term context. However, they agree with the interpretivisit position that investigation of social science phenomena should not be based on the status quo, be pragmatic or objective in all aspects (Neuman, 2000), as it fails to capture the rich, social context and is antihumanist. Tite (1998) illustrates the differentiation between the critical social science approach and the other two by stating: -

> *"While positivist and interpretivist researchers tend to work from the concrete to the abstract, critical researchers work by moving from the abstract to the concrete. Items from a survey, for example, are generally seen as observable facts that we can explore until we find what seems to be the core or defining features so that we can formulate an abstract concept."*

3.3.4 Research Epistemology

This study is attempting to understand the experiences and perceptions of nine participants regarding engaged learning within AMC's ship-handling simulator. As such, the focus is to understand the participant's beliefs, attitudes and experiences with regards to their simulation environment, so that their interpretations and understandings can be captured and evaluated. Thus, the research is subjective and the interpretivist epistemology is considered to be the most appropriate.

Within the selected group of participants there are differing cultural backgrounds, levels of familiarity with simulation applications and diverse experiences and qualifications with different vessels amongst participants. By adopting the interpretivist epistemology in this study, it will capture a rich and insightful picture reflecting these influences.

Critical social science epistemology is considered to be inappropriate, as the researcher is not interested in transforming the social relations nor alter the state of the situation. Rather, the focus is on learning and understanding the thoughts and experiences of participants that they believe engage them in learning inside the Australian Maritime College's ship handling simulator environment.

3.4 Qualitative Versus Quantitative

The focus of the thesis is to gain an insight into the individuals' perceptions of the factors that provides an engaging learning experience within in a simulated ship-handling environment. Therefore, the research falls both within the category of organisation development through learning and the topic of technology in the focus on computer-based simulation application. The method chosen for the research must then also address both these topics in a satisfactory manner, and also the research questions.

The ongoing argument over the relative merits of what are generally referred to as qualitative and quantitative research approaches is largely the result of the underlying differences in their ontological and epistemological assumptions (Olson, 1995), and distinct orientations of researchers (Myers, 1997). However, as Myers points out, that "*...qualitative and quantitative research differ in many ways, but they compliment each in many ways, as well*". For example, all social researchers systematically gather and analyse empirical data to discover patterns in them and explain social life, and while one primarily uses *hard data* (i.e. numbers) and the other *soft data* (i.e. words, sentences, impressions etc).

Quantitative methods are generally focused on statistical analysis, and data is typically collected from surveys or experiments, which does not allow the researcher to be intimate, or immerse themselves, with the lives of the participants, or the social setting (Babbie, 1999). In the quantitative approach, variables are identified and isolated before collection of data is initiated (Ahdell and Andresen, 2001). This results in a construction of a scientific model (positivism) of the research work and formalising and structuring the approach to the research question(s). Quantitative data is usually confined to numbers, so that analysis is independent of context and objective (Neuman, 2000). The data is often collected and compiled from experiments and surveys, and rarely provides insight into areas where data samples are too small to make a conclusive outcome.

Qualitative methods are very much different from quantitative, in the manner where it usually focuses deeper on specific questions, and was developed to enable researchers to study cultural and social phenomena (Myers, 1997). This means that researchers can learn and understand people and the social and cultural contexts within which they live. Qualitative data sources may include observations, interviews, questionnaires, documents and the researcher's impressions and reactions (Myers, 1997). Such flexibility in qualitative research makes it easier to investigate and answer the 'how' and 'why' questions to a particular phenomena. However, they are more subjective and findings are harder to generalise in other research work.

It is crucial to be aware that quantitative and qualitative methods have an array of differences (*see table 3-1*); it doesn't necessarily mean one method is better than the other. It is best to appreciate the strengths (and weaknesses) each method has to offer (Neuman, 2000). So, the more important question is not which method to adopt but rather what is it you want to learn or to understand? Meaning (typically expressed qualitatively) or truth (typically expressed quantitatively) (Carr, 1994)?

Quantitative Research	Qualitative Research
Test Hypothesis that the researcher begins with.	Capture and discover meaning once the researcher becomes immersed in the data.
Concepts are in the form of distinct variables.	Concepts are in the form of themes, motifs, generalizations, and taxonomies.
Measures are systematically created before data collection, and are standardised.	Measures are created in an ad hoc manner and are often more specific to the individual setting or researcher.
Data are in the form of numbers from precise measurement.	Data are in the form of words and images from documents, observations, and transcripts.
Theory is largely causal and is deductive.	Theory can be causal or non-causal and is often inductive.
Procedures are standard, and replication is assumed.	Research procedures are particular, and replication is rare.
Analysis proceeds by using statistics, tables, or charts and discussing how what they show relates to hypotheses.	Analysis proceeds by extracting themes or generalizations from evidence and organising data to present a coherent, consistent picture.

Table 3-1 Differences between Quantitative and Qualitative Research.

(Source: Neuman, 2000)

As to ask whether qualitative or quantitative methods are "better" will always be debated by both schools as illustrated in an article published in the *British Journal of General Practice* (2001) discussing this very issue and explained that it: -

> *"...is similar to arguing over whether rainbows are better than cheese sandwiches. Each serves a different function and has an appropriate place in the complex taxonomy that constitutes the totality of our experience. The cheese sandwich can be weighed, measured, and analysed with respect to its biochemical constituents, and for the purposes of relieving hunger, it is unequivocally better than the rainbow. But for making a young child smile with wonder on a stormy day, the rainbow probably has the edge."*

Finally, due to the nature of the research, it has been considered ideally to take a qualitative, interpretive approach into the use of interviews. The aim of the research questions is to produce a rich picture of the AMC's ship handling simulator by revealing the perceptions of the users in what engages them in the learning process and their thoughts working in a team-oriented setting.

3.5 Research Design for Data Collection

This section outlines the research design with regards to data collection in the study. It examines the two field research techniques adopted by the researcher: semi-structured interviews and observations. Also, it discusses the suitability of a case study method in this research program.

3.5.1 Case Study

A case study method is suitable for studies that are exploratory in nature, where the focus is in understanding the workings in a single environment to capture the reality of the situation or the experiences of people while preserving the context in which they operate (Benbasat, Goldstein et al., 1987). To differentiate between the strategies, we have to determine what questions we are trying to answer (i.e. how, what, why, how much, etc) and the expected outcomes we hope to achieve (Yin, 1988). Another contributing factor to the selection process is the ability to control the setting of the experiment and whether the research is present or past focused.

Yin (1988) also supports the idea of a case study method when data is collected by multiple means and states, "*...the case study's unique strength is its ability to deal with a full variety of evidence – documents, artefacts, interviews and observations*". It also allows a researcher freedom to update the data material. However, Yin also notes the "*...a concern about case studies is that they provide little basis for scientific generalization*". From the researcher's standpoint, this is acceptable as the focus is not to generalise the findings from the study, but rather to generate a rich picture and give insight into some future research implications in this particular field.

Comparing the situation with the research strategies, the conclusion was reached that the case study design would best suit the research requirements. This method is appropriate for this area of study as the core research purpose was to capture a rich picture of the experiences and thoughts of AMC's ship handling students - within their context - in regards to engaged learning. Also, it was further justified as "how" and "why" questions were asked, no control over the setting of the experiment and the order of actions in the research was available and the research satisfied a majority of the key characteristics of case study research identified by Benbasat, Goldstein, and Mead (1987) (see *table 3-2*). Lastly, a set of propositions will be identified from the case study to better understand the phenomena and in order to build basic theory.

Characteristics of Case Studies	Research Study
The phenomenon is investigated in its natural environment.	*The participants were interviewed and observed in AMC's simulation centre and ship handling simulator respectively.*
Data are collected by several means.	*Data was collected by observations and semi-structure interviews.*
One or few people, group or organisations are investigated	*Nine AMC shipmaster students were interviewed and ten in observations.*
The intricacy of the entity is studied thoroughly.	*The focus was on the relationship between individuals' perceptions of engagement and the simulator as a learning tool.*
The method suits exploratory research.	*Little research has been done in this area especially with a simulator of this size and complexity.*
No experimental controls are involved in the research	*This study did not involve experimental controls.*
The investigator does not state any independent and dependent variables prior to the research conducted.	*There was no independent and dependent variables stated prior to this research.*
The outcomes produced from the research depend upon the ability of the research to synthesize observations.	*The outcomes of this research was derived from both observations and semi-structured interviews, greatly depended upon the researcher's ability to synthesize the data from those two field research techniques.*
The site selection and data collection methods chosen may alter as the researcher forms new hypothesis and theories.	*N/A*
Case research method is helpful when the research is interested in asking "why?" and "how?" questions, as these types of questions are adept in assisting the researcher in understanding or describing a community of interacting individuals as opposed to frequency or rate of reoccurrence.	*The type of data collected was based upon "how" and "why" questions.*
The focus of the research is centred upon current events.	*The ship handling simulator began operations approximate three years ago, therefore, the focus of this research is current.*

Table 3-2 Characteristics of Case Study Research

(Source: Benbasat, Goldstein, and Mead, 1987)

3.5.2 Semi-structured Interviews

Semi-structured interviews are one of the most frequently used qualitative methods in capturing the beliefs and thinking of an individual in a particular domain. As Kvale (1996) points out that: -

> *"...qualitative research interview seeks to describe and the meanings of central themes in the life world of the subjects. The main task in interviewing is to understand the meaning of what the interviewees say."*

Its combination of faith in what the subject says with the scepticism about what she/he is saying and the underlying meaning induces the interviewer to go on questioning the subject in order to confirm the hypothesis about his/her beliefs (Honey, 1987). In some cases, questions may not have the same meaning for every participant and so this approach can be adopted to unmask the real meanings through reflection and exploration of the subject's response.

Compared to other techniques, such as, surveys or questionnaires, which is often structured and formulated ahead of time, semi-structured interviews lack the flexibility to deepen and clarify concepts from participants (Kvale, 1996). Some surveys even limit the participant's response through the construct of predefined selections.

A semi-structured interview approach was adopted because one of the key aims of the research is to capture the rich picture of the simulation users' experiences, opinions, attitudes and awareness inside the ship-handling simulator. The opened nature of the interview questions ensured that participants would have the autonomy to speak freely and be able to expand into different areas of the question's scope. Furthermore, it provides the researcher with the framework to narrow down the topic of interest and presents an opportunity for the participant to offer their understanding and perceptions.

3.5.3 Observations

An observation is a field research technique used to observe subjects or individuals in their daily work routine or on special tasks. The purpose of observation is to witness what is going on at the meeting and witness the group dynamic in process (Mittmans, 2002). This can be a rich information source as it can gives researchers insight into the group.

By introducing observations into the study, it enabled the researcher to understand the individual participants' behaviour and other personal characteristics in a team-oriented environment. Combined with the semi-structured interviews, it can establish a chain of evidence underlying the formation of responses from participants, and how they drew those conclusions.

3.6 Selection of Interviewees

This following section discusses the procedure and justification for the selection of participants in the interviews and observations in the study.

3.6.1 Purposeful Sampling

There are two broad types of sampling strategies generally used by researchers: purposeful sampling or probability sampling (Almedom, Blumenthal et al., 1997). Since the nature of this research is to select information rich cases for in-depth study and to employ sampling procedures that will allow for the most insightful data collection in answering a particular question or exploration (Schatz, 2001), purposeful sampling is more appropriate of the two. Probability sampling is a method that utilises some form of random selection and is more likely to be employed in quantitative studies (Trochim, 2002).

Neuman (2000) also points out that "*...with purposive sampling, the researcher never knows whether the cases selected represent the population. It is used in exploratory research or in field research*". Also, this research encompasses other field research techniques including observations, case study and semi-structured interviews. Thus, purposeful sampling technique is the logical choice under these circumstances.

3.6.2 Participant Selection Process

There are over sixteen different types of purposeful sampling and each has its own unique characteristics to sample different problems or phenomenon (Patton, 1990). For this research, the criterion, or theoretical sampling technique was adopted. This comprised of only selecting participants who met some pre-conditions or criteria. This technique was introduced since it was critical that participants had regular access to the simulator so the researcher was able to witness and evaluate them in the simulator (see *table 3-3*).

Type	Details
Extreme and deviant case sampling	This involves learning from highly unusual manifestations of the phenomenon of interest, such as outstanding successes, notable failures, top of the class, dropouts, exotic events, crises.
Intensity sampling	This is information rich cases that manifest the phenomenon intensely, but not extremely, such as good students, poor students, above average/below average.
Maximum variation sampling	This involves purposefully picking a wide range of variation on dimensions of interest. This documents unique or diverse variations that have emerged in adapting to different conditions. It also identifies important common patterns that cut across variations. Like in the example of interviewing SJU students, you may want to get students of different nationalities, professional backgrounds, cultures, work experience and the like.
Homogeneous sampling	This one reduces variation, simplifies analysis, and facilitates group interviewing. Like instead of having the maximum number of nationalities as in the above case of maximum variation, it may focus on one nationality say Americans only.

Typical case sampling	It involves taking a sample of what one would call typical, normal or average for a particular phenomenon
Stratified purposeful sampling	This illustrates characteristics of particular subgroups of interest and facilitates comparisons between the different groups.
Critical case sampling	This permits logical generalization and maximum application of information to other cases like "If it is true for this one case, it is likely to be true of all other cases. You must have heard statements like if it happened to so and so then it can happen to anybody. Or if so and so passed that exam, then anybody can pass.
Snowball or chain sampling	This particular one identifies cases of interest from people who know people who know what cases are information rich, which is good examples for study, good interview subjects. This is commonly used in studies that may be looking at issues like the homeless households. What you do is to get hold of one and he/she will tell you where the others are or can be found. When you find those others they will tell you where you can get more others and the chain continues
Criterion sampling	Here, you set a criteria and pick all cases that meet that criteria for example, all ladies six feet tall, all white cars, all farmers that have planted onions. This method of sampling is very strong in quality assurance.
Theory based or operational construct sampling	Finding manifestations of a theoretical construct of interest so as to elaborate and examine the construct.
Confirming and disconfirming cases	Elaborating and deepening initial analysis like if you had already started some study, you are seeking further information or confirming some emerging issues which are not clear, seeking exceptions and testing variation
Opportunistic Sampling	This involves following new leads during field work, taking advantage of the unexpected flexibility.
Random purposeful sampling	This adds credibility when the purposeful sample is larger than one can handle. Reduces judgement within a purposeful category. But it is not for generalizations or representativeness.
Sampling politically important cases	This type of sampling attracts or avoids attracting attention undesired attention by purposefully eliminating from the sample political cases. These may be individuals, or localities.
Convenience sampling	It is useful in getting general ideas about the phenomenon of interest. For example you decide you will interview the first ten people you meet tomorrow morning. It saves time, money and effort. It is the poorest way of getting samples, has the lowest credibility and yields information-poor cases.
Combination or mixed purposeful sampling	This combines various sampling strategies to achieve the desired sample. This helps in triangulation, allows for flexibility, and meets multiple interests and needs. When selecting a sampling strategy, it is necessary that it fits the purpose of the study, the resources available, the question being asked and the constraints being faced. This holds true for sampling strategy as well as sample size.

Table 3-3 Purposeful Sampling Types

(Source: Schatz, 2001)

3.6.3 Selection Outcome

The total number of students in the Shipmaster's course was ten, and each was introduced to this research via a formal letter that outlined the purpose and nature of the study. This resulted in the response of nine individuals who agreed to participate as subjects.

3.7 Interview Procedure

The following section outlines the procedures employed to conduct the interviews. It explains how the information letters were distributed, the interviewing framework and how the interview was approached.

3.7.1 Introductory Information Letters

At the first meeting between the researcher and potential participants of this research, information letters was given to each individual. The information letter, *see appendix A*, introduced them to the purpose of the research, the researcher, described the confidential and privacy guidelines, outlined how interviews would be conducted and contact information regarding both the researcher and the Tasmanian Northern Ethics Committee. An informal, verbal approach was adopted to determine if each participant was willing to take part of the research and then an appointment was organised to conduct the interviews.

3.7.2 Interview Approach

Being by nature an open-ended, individual interview process, it was important for the researcher not to be overly directive or passive with each participant. Being too directive reduces the opportunity for the participant to freely express their thoughts, opinions and beliefs, and so does not capture the richness of his or her experiences. Secondly, if the researcher is too passive by not responding appropriately or do not continue to attain more details from the response then the participant may perceive the researcher to have a lack of interest.

As the researcher is inexperienced with the shipping and computer simulation industry, a passive approach was initially taken and adopted a more direct approach when participants moved outside the scope of the question or had difficulty articulating their experience. This was to create an environment where each participant would feel comfortable and the whole process would not seem to threatening.

3.7.3 Interview Framework – Topics of Interest

This section outlines the interview framework, *see appendix C and D* for the list of interview questions, for round one of questions used by the researcher to capture meaningful data from the voluntary interviewees. A framework was established because it provided the researcher a structured and firm base to probe the participant, and allowing greater flexibility to investigate issues of value during the course of the interview. Furthermore, it ensured each participant was given the same initial platform to which they could respond.

Background Information

This was to gather some basic information and establish the level of experience interviewees had with simulation applications, computer literacy levels and the purpose for using the ship handling simulator.

Vision of Learning

This section was fairly diverse and covered a number of issues regarding learning including the particiapants' thoughts on user-directed learning, working in a team-oriented environment and ways to improve learning with simulation technology. It was an attempt to reveal the participants' experiences and opinions, and to discover whether the simulator was generally effective.

Tasks

This section sought to discover the participants' viewpoint on the objectives, exercises or tasks they had to complete. It was aimed to determine if the tasks were reflective of the real work, and better understand the impact it had on their skills and experiences.

Assessment

This section was interested in understanding the effects of the simulator on the learning capacity of the participants, and to reveal any changes to their competence or performance levels.

Collaborative Learning

This section was to determine how the participants working in a team-oriented environment perceived the content and program structure, and how the simulator (and its related setup) affected their knowledge and skill building.

Teacher Roles

This section was to determine if the teacher roles has been affected by the change in learning models and styles, and how this would affect the delivery of education to participants. It also revealed the thoughts of participants of the contrast between self-direct learning and teacher-directed learning.

Learning Outcomes and Expectations

This section was to discover the participants' thoughts on their learning expectations and outcomes, and whether the ship handling simulator could deliver it to them.

The second round interview were follow up questions based on issues raised in round one, and were conducted to fulfil missing gaps in the findings.

Conclusion

This section was an opportunity for the participants to reflect on what they had stated in the interview, and to describe any problems or suggestions to improve the ship handing simulator.

3.7.4 Completion of Interviews

At the completion of each interview, the participant was given the opportunity to clarify or extend any points raised during the session, and asked if they had any problems with the whole process. Furthermore, the researcher requested permission from the interviewee if it was possible to contact him or her in the future if any issues or further clarification was required.

Once the interviews were completed, it was made into transcripts to enable the data analysis process to begin. However, during the interviews, it was inevitable for some interviewees to make poor grammar mistakes while attempting to articulate their views and experiences. So, grammar and poor sentence structure issues were corrected, but it was not modified to a state where it changed the meaning and context of the participants' responses.

When the transcripts were completed, it was returned to its respective participants to verify their responses. Any correction(s) required by the participants was made. During the whole process of converting the digital audio to transcript, both forms of media were physically or/and digital protected by either a locked cabinet or a computer password using encryption software. Finally, the coding process was conducted (described in detail later).

3.8 Pilot Interview

The research into AMC's ship handling is in some aspects exploratory and so the researcher cannot fully comprehend the issues or dynamics of the social situation until familiarisation of the data has occurred. Thus, testing of the interview process is required (Miles and Huberman, 1994). Furthermore, by conducting a pilot study, it might give the researcher warning about where the research could fail or encounter problems, where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated (Teijlingen and Hundley, 2001).

3.8.1 Pilot Interview Process

The pilot participant selected for this exercise previously had some experience with the ship handling simulator for training purposes in the last 18 months, which extended over a three month period. As such, the pilot participant had the appropriate credentials and experiences to respond to the pilot interview questions. No results from the pilot study was used in the main research findings, since "*they have already been exposed to an intervention and, therefore, may respond differently from those who have not previously experienced it*" (Teijlingen and Hundley, 2001).

This pilot study also provided an opportunity for the researcher to test the effectiveness of the interview framework outline any difficulties in the style of interviewing and how the questions were posed. The interview questions were tested to ensure a general flow and to identify any dubious and irrelevant questions that required corrections. The outcome of all this, as Miles and Huberman (1994) explains, is to ensure participants understand the questions and so more meaningful data can be captured.

3.8.2 Identified Problematic Areas

The pilot interview exercise identified several minor problems and difficulties. These included: -

- There were several questions that the participant did not understand because of the terms used, such as abbreviations and so was amended to correct this problem. When the participant still did not understand the terminology, clarifications and examples were also given.

- Often the participant strayed off the scope of the interview question and expanded into other irrelevant areas. In order to address this, the researcher ensured the conversation was as relevant as possible at all times, and comments or questions were asked to put the participant back on track.

- The pilot interviewee made a point of the interview being fairly long and tedious. So, the researcher resolved this issue by splitting the interview into two rounds to assist the participant in maintaining attention, and to also allow the researcher to follow up on questions and responses raised in the previous round.

3.9 Data Analysis

The data analysis techniques adopted for the interviews was a three stage coding process. It was a bottom-up approach where the aim is to attach a code to each theme found within the data (Strauss and Corbin, 1990). Essentially, the data analysis involves reading the transcribed data line by line, and dividing the data into meaningful analytical units (Johnson, 2002). As each meaningful segment was discovered, a code was attached to them. From this, it could then be used to identify and construct the major themes and subcategories from the interviewee's narratives. This coding process was also introduced to minimise the bias of the researcher as it used words and phrases spoken by the participants (Strauss and Corbin, 1990).

Coding seeks to reduce mountains of raw data into manageable piles and enable the researcher to quickly locate relevant aspects of the analysis (Neuman, 2000:421). In tagging codes to the data such as words, sentences or paragraphs, it ensures an underlying chain of evidence in the formulation of findings (Yin, 1988; Paynter and Pearson, 2000:6).

Straus and Corbin (1990) have identified coding to be typically a three stage process: open coding, axial coding and selective coding. Each of these stages is discussed in detail in the following section.

3.9.1 Open Coding

Open coding is performed during an initial pass through the transcribed data. This is the first opportunity for the researcher to read the data and absorb its meaning. It is also the first attempt for the researcher to identify themes and assign initial codes or labels to compress and classify the mass of data into categories (Neuman, 2000:421). These themes are at the low level of abstraction and emerge from the research questions, concepts in the literature, language used by participants or new views that stem from the data (Neuman, 2000:421).

According to Strauss and Corbin (1990), a benefit of the bottom up approach in the data analysis is that the construction of themes are grounded from the narratives of the interviewees. Thus, the themes were not identified before the data analysis process was initiated, instead it was developed after the researcher evaluated the data (Strauss and Corbin, 1990).

3.9.2 Axial Coding

Axial Coding is the second pass through the data. During open coding, the researcher is focussed on assigning codes to themes without the concerns of establishing relationships among themes, or elaborating about the concepts they represent (Neuman, 2000:422). In contrast, the second pass is aimed at to sharpen and group identified categories into new higher-level categories according to common themes (Strauss and Corbin, 1990). Additional themes may emerge from the axial coding but the primary task is to review and examine initial codes.

Neuman (2000:423) also adds that during axial coding: -

> *"...a researcher asks about causes and consequences, conditions and interactions, strategies and processes, and looks for categories and concepts that cluster together. He or she asks questions such as: Can I divide existing concepts into sub dimensions or subcategories? Can I combine several closely related concepts into one more general one?"*

3.9.3 Selective Coding

Selective coding is the third pass through the data. By this stage of the data analysis, all the major themes should be identified (Neuman, 2000:423).

The selective coding involved inspecting the data and prior codes in which the researcher attempted to select cases that outline themes via comparisons and contrasts. This phase also required the researcher to determine the core categories central to the research, and how other sub categories became systematically linked with it (Coffey and Atkinson, 1996).

3.9.4 Categorical Aggregation or Direct Interpretation

Two strategic methods that researchers employ to attain new meanings about cases is achieved through direct interpretation of instances or categorical aggregation of instances (Stake, 1995). Both methods involve a search for patterns among the data collected.

In categorical aggregation, a researcher seeks repeated instances from the data, anticipating issues and to produce relevant meanings. This process involves categorising codes into a hierarchical taxonomy whereby codes with similar meanings are categorised into higher-level categories, and then grouped as subcategories of higher-level categories (Stake, 1995). The core categories are then derived from this aggregation method.

In direct interpretation, a researcher examines and determines the meaning attached to a single instance without the use of a coding hierarchy (Stake, 1995), in contract, to categorical aggregation. During the procedure, patterns are extracted from the data, and occasionally, the patterns may suggest that a relationship may exist between categories.

Often the codes developed by procedures of open, axial and selective coding are still too low-level to allow the generation of findings other than through direct interpretation (Stake, 1995).

3.9.5 Model Building

The core themes or categories form the underlying basis of a model of the phenomena being observed. However, a rich model consists of greater details, such as, relationships both within core categories and between them. One of the objectives of the research is to build models representing a holistic view and categorical views of the phenomena to provide insightful relationships and hopefully provide a base for future research in this field. The relationships examined and constructed during the model building process was an iterative process and from a bottom-up approach.

Furthermore, just as the coding and findings was approached from an interpretive perspective, the formation of the theoretical model was no different as it was based on the thoughts and experiences of a few selected Australian Maritime College participants.

3.10 Validity

In qualitative research, it is important to demonstrate a transparent process as there are concerns surrounding the validity of the researcher's interpretations and analysis of the data. As Cano (2000) states

> *"....all interpretations are subjective, so the issue here lies in tracing the ways by which you have arrived at this particular interpretation. In other words, you are responsible for showing that you did not "invent" your interpretations, but that they are the product of conscious analysis".*

For this study, validity was achieved through the following means:

- During the interview process, examples and follow-up questions were prepared, to either clarify or rephrase the question, or to add examples that would help the interviewee avoid any misunderstandings. Furthermore, at the end of each interview, the researcher would offer an opportunity for the participant to determine if they were happy with their answers and if they wanted to review any.

- The researcher's assumptions, methods and procedures are clearly outlined in this chapter regarding how the data was collected and analysed, and hence instilling transparency into the study. More importantly, it provides readers with insight into the formulation of results and conclusions, and allows them to evaluate the validity of this research.

- Unbiased data is difficult to guarantee in qualitative research since some answers can be used to draw different conclusions, for example, by taking quotes out of context. In order to prevent this from happening and to add rigor to the data analysis process, interviewees were offered the opportunity to examine the analysis and results from the interviews. This is often referred to as 'member validity' (Neuman, 2000).

- During the three stages coding process, outside was sought from another information systems researcher. Although inter-coder reliability is not required in interpretive research, the researcher believes it to be helpful. Thus, the third party was only able to evaluate the researcher's interpretations of the raw data without understanding its true context, criticism and advice was still taken into consideration whenever it was given. Even if it was better to independently code the transcripts with the assistance of multiple researchers or individuals (Ratcliff, 1995), limitations of time and resources inhibited this from happening.

3.11 Chapter Summary

The objective of this chapter was to illustrate the ontology, epistemology and research methodology adopted with respect to this study. It also outlined and justified the philosophical and methodological approach of the researcher in the attempt to add rigor to the research design. Thirdly, it described the methods and techniques chosen to analyse the data in order to add transparency to the whole process. Finally, the validity and limitations of the research findings was discussed to increase the reader's perspective of the credibility in both the researcher and the study itself.

Chapter Four

Analysis

"If you are planning for a year, sow rice; if you are planning for a decade, plant trees; if you are planning for a lifetime, educate people."

Chinese Proverb

4.0 Chapter 4 – Analysis

4.1 Chapter Introduction

This chapter is dedicated to the analysis of the data gathered from the interviews, and offers snap shots of how the core categories and sub-themes are derived from the transcripts. Each coding phase is highlighted and illustrated with examples to provide a transparent account of how the researcher analysed and interpreted each component of the data. More importantly, it offers insight into a sequential process demonstrating the validity of the techniques adopted by the researcher, and how the data was dimensionalised through open coding, axial coding, categorical aggregation and selective coding.

4.2 Cameos

Below is a thick, narrative description of the initial contact, observation and interview with some selected participants.

4.2.1 Initial Contact

During the early stages of my research program, contact was made with a number of people from the Australian Maritime College involved in the operation of the ship handling simulator. Fortunately, after talking with the technical manager, Ian Smith, he was able to refer me to a colleague, Ian Shea, responsible for the training of students striving for Shipmaster certification. His students would require weekly access to the ship handling simulator for approximately two months, and this provided me with the ideal opportunity to gather voluntary participants for both observation and interview purposes.

First contact with the students was initiated through the assistance of Ian Shea, which I deemed to be the most appropriate method to introduce myself and the research program, and to satisfy the requirements outlined by the Northern Tasmanian Ethics committee. I sent an introductory letter to Ian Shea regarding my research program after talking with Ian Smith. Within two weeks, I received an email reply from Ian in which he agreed to provide assistance in my research and requested to meet me in person to discuss my work and details regarding the involvement of his students.

As I walked into the designated room in the bridge simulator building, I spotted Ian and what seemed a handful of his students gathered at one end of the room. I casually moved towards Ian and we exchanged greetings before engaging in a conversation. He informed me that I was early and that his remaining students have yet to arrive. It was only a week earlier that I had met Ian in person discussing the intimate details of my research and where he spoke openly about his interest in my research regarding the simulator, particularly, the qualitative/social nature of it. Now, he was here to help me make this a reality. After a few minutes into our conversation, Ian glanced at his wristwatch and looked around the room. He said his students were all here and that he should introduce me to the class. I was nervous but ready.

Ian called the students to his attention and briefly stated the purpose of my research as I watched the reactions on their faces. He then introduced me to the class and then stepped aside to let me take over. I began to explain the purpose of my research, the role of their involvement, and handed out a two page letter to each student in the room. Immediately, there were a few students who was genuinely interested by the study and asked for more information regarding their involvement, and what methods I would employ to collect the research data. I knew my initial meeting with my potential subjects would be vital in enticing them to participate in my study, and towards making a good "first impression", so I responded with both humour and enthusiasm whenever it was possible.

After Ian had given a briefing on the simulation exercise, I seized the opportunity to move around the room to speak to each individual. I believed this was important as it would be the first step to establishing a relationship with my potential research subjects, and put down a firm foundation for trust building in the coming weeks.

Fortunately, there seemed little resistance to my intrusion and they appeared to be very open-minded about my research work. As I expected, a majority of them asked for greater detail regarding my research when I spoke to them on an individual basis. This eventually led to avenues of communication where I was able to begin profiling the character and personality of each potential participant.

As I spent the next hour chatting with the students about the simulator and their careers in general, what really struck me was the students' willingness in sharing their personal experiences working in the maritime industry. This gave me immerse insight into their lives and of an industry which I have previously little or no knowledge of. They spoke warmly, and with humour, about their travels around the world - I was bewildered and amazed at what they have experienced in just a few short years in the industry - and what they hope to achieve in the future. I began to comprehend why some of these individuals are willing to spend significant amounts of time away from their family and friends other than the reason of 'just good money'.

There was one student at the initial meeting which caught my attention since he had prior experience managing a bridge simulator with the Australian NAVY. When I asked him about how he felt about the simulator as part of his training, he spoke very positive of it, and was confident it would improve his ship handling skills. I was surprised at this admission as the other students, with less or little experience with the technology, perceived it as primarily the 'fun' and 'practical' aspect of their course. I had some suspicion this may change in the latter stages of the course.

4.2.2 Observation

When I arrived for my first observation, a week after the initial meeting with the students, I was nervous at how they would receive me as a neutral observer. Previously, I've had little experience in the area of qualitative research, even less, regarding its data gathering techniques. Cautiously, I walked into the bridge compartment of the simulator where I was greeted by dark figures all around. Unfortunately, because of the lack of lighting, I simply replied 'hello' and moved towards the side of bridge to observe. As my eyes adjusted to the dim lighting in the room, I began to survey the surrounding instruments out of curiosity, and was quickly impressed by its sophistication. The environment was a replicate of a real-size bridge with standard interfaces and controls. I recognised the radar screens, the motor controls, the navigation wheel situated near the centre of the room and the visual aids displaying the speed and direction of the ship's heading. However, the most intriguing, and eye catching, aspect of the simulator was the visuals, which was projected on a 180 degree screen – giving everyone in the simulator a semi-circle view of the computer generated environment. I half expected the visuals to 'jerk' around before stepping into the bridge simulator since the computation power required in rendering simulations to be significant but this was not the case.

While I was adjusting to the simulator, Ian described to the participants the purpose of the scenario, and some of the peculiar behaviours of the ship he was navigating. The students seem focused and was not afraid to ask questions when clarification was required. During the demonstration there was rarely any chatter between the students, and when it did occur, it was mainly about how Ian had executed a set of manoeuvres or issues related to his navigation in general. It occurred to me that knowledge was not only gained or shared from the instructor but also between each student. It confirmed that students were able to analyse and discuss critical manoeuvres in real time, and examine feedback by observing Ian's responses and actions to the simulation exercise.

When the simulation session came to an end, Ian gave a brief overview of the actions he had undertaken and to re-emphasise the objective(s). Some participants took this opportunity to further question his decision making and asked about the viability of other alternative actions. In response, Ian provided detailed answers to their questions and encouraged them to experiment to test their manoeuvring theories. He then walked out of the bridge and returned with a paper printout detailing the vessel's movements and actions from the previous simulation. Everybody in the simulator crowded over a small table where Ian placed the printout, with a desk lamp offering the only source of light. He highlighted the movements of the vessel and offered advice to improve the manoeuvres. Once again, he asked if anybody had questions before they undertook the exercise themselves but no one spoke a word. It was apparent that everyone had a good idea of what was expected to successfully complete the exercise. Ian then walked out of the simulator.

Due to work commitments, I shortly followed Ian out the door. I knew I would have plenty of opportunities to observe and better understand the participants over the next 2 months.

4.2.3 Interviews

Before the start of the one-on-one interviews, I quickly went around the simulator to remind the participants that I would be conducting the interviews today, and that the whole process was voluntary. Although a majority had previously given me their permission, it was an opportunity for them to decline the invitation if they had a last minute change of mind. Fortunately, no one declined and I was happy to proceed. Since the interviews overlapped with their weekly bridge simulator practical, I was able to select participants who were waiting for their turn on the simulator. Jack was the first participant I selected for a one-on-one interview since I acknowledged him to be one of the more open-minded people I encountered in the group, and who at the very beginning, showed interest in my research program. I calmly moved from the side of the bridge simulator and requested permission to conduct an interview that I estimated would last approximately 25-30 minutes. He agreed, and I led him to the control room behind the bridge simulator where Ian had set aside for me earlier.

The control room we entered for the interview was well-lit, and was very convenient for both the participant and interviewer. It gave both of us a full view of the simulator from the rear and would hopefully make it easier for Jack to explain his responses if he needed to describe some of the physical aspects of the environment he worked in.

Before switching on the digital voice recorder, I gave him a brief overview of my research program and its intended purpose. He listened intently, but had no objections or queries. He then signed the interview consent form I placed before him.

To make my interviewee comfortable and lessen any nerves, I employed a practise interview run, and let Jack get a 'feel' of the direction of my questions, and to seek answers to any issues he may have. Fortunately, he did take advantage of it. As he read the list of interview questions, he queried what certain questions meant, and to which I gave him satisfactory responses by either explaining what I expected in general or reworded the question in a manner that he could understand. By the end of the exercise, he was confident and eager to get started. I switched on the digital voice recorder, and began the interview.

The first section of the interview was very straightforward since it seeks to uncover the background of the participant with regards to experience with (simulation) technology, and how he perceived the role of the simulator in his learning process. One of the early highlights of the interview was when I probed Jack about self-directed learning, and he was able to identify strong linkages between future job opportunities and aligning real-world applications with the learning he was receiving. This was later enforced by the majority of participants as well since most of the interviewees have little ship handling experience. Jack seemed very positive with regards of employing the simulator in his learning, and often reiterated the value and necessity of the tool.

As the interview progressed, I noticed Jack became more comfortable and would not seek my approval with the response at the end of each question as he did at the beginning of the session. For example, by saying "is that what you're looking for?" In addition, when I requested more in-depth replies, he was happy to expand on responses and give examples. I also was relieved that Jack did not give one or two word responses, which I was dreading the previous day, and he didn't seem to lose interest during this intensive period. When the questions were all answered, I sincerely thanked Jack for his time and contribution. He didn't seem to mind the interview at all but was happy it was over. We shared a smile or two, and I led him back into the simulator where the others were. Before taking the opportunity to select my next interviewee, I made a remark to the general audience in the simulator at how tough the interview was and that Jack was sweating from my interrogation. He shook his head but we both had a grin on our face.

4.3 Data Analysis

4.3.1 Open coding

As discussed in the previous chapter, a bottom up approach was employed to code the data collected via interviews. The first phase is called open coding and is performed on the data collected and transcribed from all the interviews with the unit of analysis completed at the sentence level. An example of the open coding process is shown below (see *table 4-1*):

Response
"Oh definitely. It's good watching other people – it's good watching people making mistakes. It's good watching other people make mistakes and see them try to pull

themselves out of it."
Label Learning from Observation - Mistakes
Definition The respondent believes that observation of other team members and their general ship handling in the simulator, particularly the making of mistakes, is considered to be a positive aspect of his learning.
List of Referents • "It's good watching other people" • "It's good watching other people make mistakes and see them try to pull themselves out of it."

Table 4-1 Open Coding

4.3.2 Axial Coding

Axial coding is the second phase of the coding process where it is aimed to sharpen and group identified categories into new higher-level categories according to common themes. This can be achieved through the process of code dimensioning (see *table 4-2*) and/or code unification (see *table 4-3*).

Axial Coding – Code Dimensioning Code dimensioning is one aspect of the axial process where two or more labels are replaced by more abstract or appropriate labels, typically, under one group or class.
Open Codes Classroom Learning Approach

Simulator Learning Approach
New Codes Learning Approach – Passive Learning Approach – Active

Table 4-2 Axial Coding – Code Dimensioning

Axial Coding – Unifying Codes The second common method of code abstraction in the axial coding phase is unifying, or replacing, two or more existing codes with one.
Open Codes Job Benefits – Ship Handling Skills Greater Real-world Promotion Opportunities
Single Code Future Job-based Advantages

Table 4-3 Axial Coding – Unifying Codes

4.3.3 Categorical Aggregation

Once the axial coding phase was completed, the new codes were sorted and grouped under higher level categories that shared similar themes or meanings. The purpose is to identify and form core categories from the axial codes. This process of categorical aggregation is a tedious process as the same sets of axial code can be used to develop multiple categorical hierarchies. Thus, the researcher had to approach this with care and attempted to capture not only the context of these codes but also the underlying meanings to develop a categorical hierarchy, see *Table 4-4* for example, that best represented the sematic values of the results.

Learning Focus

1.1 Feedback

1.1.1 Simulator Printout

1.1.1.1 Tracking

1.1.1.2 Decision Making

1.1.1.1.2.1 Mistakes and Actions

1.1.2 Group Discussion

1.1.2.1 Encourage Constructive Thinking and Reflection

1.1.2.1.1 Alternative Solutions

1.1.2.1.2 Learning from Errors

1.2 Learning Styles

1.2.1 Approach

1.2.1.1 Passive Learning – Classroom

1.2.1.1.1 Learning Difficulties

1.2.1.1.1.1 Lack of Concentration

1.2.1.1.1.2 Material Hard to Grasp and Memorise

1.2.1.1.2 Relevancy of Role

1.2.1.1.2.1 Theories

1.2.1.2 Active Learning – Simulator

1.2.1.2.1 Effective

1.2.1.2.1.1 Increased Understanding

1.2.1.2.1.2 Content is Easier to Learn

1.2.1.2.3 Enjoyable

1.3 Perceptions of Learning

1.3.1 Knowledge

1.3.1.1 Validate Existing Skills

1.3.1.2 Attain and Regenerate Existing Knowledge

1.3.2 User Driven

1.3.2.1 Minimal Instructor Intervention
1.3.2.2 Bridge Resource Management
1.3.2.2.1 Challenge and Response
1.3.3 Opportunity
1.3.3.1 Ship Handling
1.3.3.1.1 Understand Differing Vessel Characteristics
1.3.3.1.2 Validate Theories
1.3.3.2 Role Play
1.3.3.2.1 Undertake Senior Officer Duties
1.3.3.3 Future Job-based Advantages

Table 4-4 Categorical Aggregation

4.3.4 Selective Coding

The final phase of the coding process is selective coding and is where evidence is sought to support the derived core and sub categories. This is achieved through two main methods including:

- Distinct patterns of codes that is identified to directly support the interpretation of one or more core categories.
- *In vivo* and extended comments (words which were used by interviewees) from participants that support the existence of core categories.

Core/Sub Categories	**In vivo and Extended Comments**
Feedback • Group Discussion o Encourage Constructive Thinking and Reflection	"At the end of each run, we sort of look at what we've each done and work out where we went wrong. That's the best way to learn!" "...it doesn't worry me too much. Those sorts of comments in there are fairly constructive, just trying to help you get on the right track at times." "Any criticism or advice that is offered is usually either constructive or you don't want to listen to it." "Yeah. Pretty good feedback..."

Table 4-5 Selective Coding

In chapter 5, *Findings*, there are extensive examples of selective coding that support the derived core categories and sub-themes.

4.4 Limitations

Due to the time restrictions of the research program and access to certain resources, the amount of effort placed into the data analysis was limited. It was difficult to achieve theoretical saturation to a level that was practical under the circumstances.

Second, lack of access to qualitative research software tools, such as, Nudist made it even more problematic to manage the large number of codes and labels that emerged from the coding process. Instead, the researcher had to employ the traditional methods of coding by hand and organising and sorting the paper-based codes on a large table, which was adequate in deriving the research findings.

Finally, the inexperience of the researcher in the qualitative data/coding process was also a factor that influenced how the data was interpreted. The impact was limited through the coaching and support from the researcher's supervisor who not only provided support but continuous mentoring.

4.5 Chapter Summary

The purpose of this chapter was to provide some insight into the exercises adopted to gather research data, the data analysis process, and how the researcher employed techniques to derive the findings.

The cameos provides a thick, narrative description of what it was like for the researcher to be amongst its subjects, and in a way, acknowledge the research's subjectivity and why it is important to be immersed into the participants' learning environment.

The snapshot into the coding process, where codes and labels are generated in a bottom-up approach in defining the hierarchy, was also an essential component in the data analysis. It provides the link in how the researcher analyse the data and from it construct a contextual hierarchy of core themes and sub categories.

Chapter Five

Findings

"Once you eliminate the impossible, whatever remains, no matter how improbable, must be the truth."
Sherlock Holmes

5.0 Chapter Five – Findings

5.1 Chapter Introduction

The chapter outlines the findings from the research conducted through semi-structured interviews and observations, and will also present a profile of the participants involved in the interview process. The findings is revealed from a three stage coding process and categorical aggregation, as demonstrated in the previous chapter, and resulted in the identification of four core categories. Within each of these different categories are sub-themes (or sub-categories) that captured the participants' experiences, thoughts and perceptions. This chapter will discuss these categories and sub-themes in detail to construct a rich picture of the users' ship handling simulator experience.

5.2 Profile of Participants

To better understand the participants within this study the researcher believes it was critical to include a basic profile of all the participants, and to provide some background information that may justify their responses in the interview process. That is, the researcher wants to offer the reader a glimpse of the participant's situation, so it is easier to comprehend the context in which the core categories and sub-themes were identified. Also, in order to protect the privacy of all the participants, each was provided with a pseudonym (see *table 5-1*).

Table 5-1 Profiles of Participants

Pseudonym	Alvin	Jordan	Anthony	Bert	Joe	John	Jack	Duncan	Charlie
Age	27	20	21	28	48	22	29	27	42
Gender	Male	Male	Male	Male	Male	Male	Male	Male	Male
Nationality	Australian	Australian	Australian	Australian	Australian	Australian	Australian	Australian	Australian
Urban/ Rural	Urban	Rural	Rural	Rural	Urban	Rural	Urban	Urban	Urban
Company	TK Shipping	TK Shipping	TK Shipping	TK Shipping	-	TK Shipping	SWIRE Pacific Offshore	SWIRE Pacific Offshore	-
Location	Hobart, TAS	Noosa, QLD	Launceston, TAS	Mornington Peninsular, VIC	Rosevears, TAS	Coffs Harbour, NSW	Perth, WA	Hobart, TAS	Cairns, QLD
Sea Farer Experience	18 Months	18 Months	18 Months	20 Months	30 Years	18 Months	6 Years	3.5 Years	17 Years
Prior Experience with Simulations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Computer Literate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The table above clearly demonstrates the diversity of age, background and experience of all the participants. However, due to the limited number of users who had (regular) access to the ship handling simulator during the time of the study and the ship handling industry predominantly made up of males, it was difficult to locate any females for this study. Every attempt was made to attract individuals of foreign nationalities to gather a greater range of perspectives but the researcher encountered resistance because of the voluntary nature of the research participation.

This selected group of participants generated a significant proportion of the research data. The following section describes in detail these core categories and sub-themes.

5.3 Core Category: Learning Focus

Learning Focus

- 1.1 Feedback
  - 1.1.1. Simulator Printout
    - 1.1.1.1 Tracking
    - 1.1.1.2 Decision Making
      - 1.1.1.2.1 Mistakes and Actions
  - 1.1.2 Group Discussion
    - 1.1.2.1 Encourage Constructive Thinking and Reflection
      - 1.1.2.1.1 Alternative Solutions
      - 1.1.2.1.2 Learning from Errors
- 1.2 Learning Styles
  - 1.2.1 Approach
    - 1.2.1.1 Passive Learning – Classroom
      - 1.2.1.1.1 Learning Difficulties
        - 1.2.1.1.1.1 Lack of Concentration
        - 1.2.1.1.1.2 Material Hard to Grasp and Memorise
      - 1.2.1.1.2 Relevancy of Role
        - 1.2.1.1.2.1 Theories
    - 1.2.1.2 Active Learning – Simulator
      - 1.2.1.2.1 Effective
        - 1.2.1.2.1.1 Increased Understanding
        - 1.2.1.2.1.2 Content is Easier to Learn
      - 1.2.1.2.3 Enjoyable
- 1.3 Perceptions of Learning
  - 1.3.1 Knowledge Management
    - 1.3.1.1 Validate Existing Skills

1.3.1.2 Attain and Regenerate Existing Knowledge
1.3.2 User Driven
1.3.2.1 Minimal Instructor Intervention
1.3.2.2 Bridge Resource Management
1.3.2.2.1 Challenge and Response
1.3.3 Opportunity
1.3.3.1 Ship Handling
1.3.3.1.1 Understand Differing Vessel Characteristics
1.3.3.1.2 Validate Theories
1.3.3.2 Role Play
1.3.3.2.1 Undertake Senior Officer Duties
1.3.3.3 Future Job-based Advantages

Table 5-2 Learning Focus

The researcher derived from the gathered data that simulation learning was highly focused in three areas: feedback, style of learning and perceptions of learning. Each is not mutually exclusive as the research derived the combination of various components is the key to successful and effective learning such as in both the generation of new skills and refining existing ones. For example, it was not uncommon for participants to identify feedback from group discussions and opportunity to validate theories as a key focus for learning in the simulator.

5.3.1 Feedback

Feedback was identified to be crucial in enabling individual users to correct mistakes in their decisions and ensure they were continuously engaged in the ship handling simulator. The various feedback mechanisms, particularly from the simulator system and group discussions, played a critical role in the learning process of the participants in enhancing the user's experience. Furthermore, it re-enforced or/and validated theoretical concepts and promoted the recall of prior knowledge.

5.3.1.1 Group Discussion

The majority of the participants expressed openness with each other in regards to comments and opinions during their simulation exercises. The importance of these discussions is highlighted by participants such as Duncan and Alvin since they believed it to encourage constructive thinking and reflection, especially, when other members are able to provide guidance, pinpoint mistakes or other seemingly incorrect decisions. This is illustrated below:

Alvin	*"At the end of each run, we'll sort of look at what we've each done and work out where we went wrong. That's the best way to learn!"*
Alvin	*"...it doesn't worry me too much. Those sorts of comments in there are fairly constructive, just trying to help you get on the right track at times."*
Duncan	*"Any criticism or advice that is offered is usually either constructive or you don't want to listen to it."*
Jack	*"Yeah. Pretty good feedback..."*

When Alvin was asked further about the feedback and the constructive input from other team members during his simulator exercises, he was happy in allowing others challenge his decisions since it attributed to good Bridge Resource Management (BRM). He concedes that incorrect decisions may be made and states that *"...they certainly have the right to challenge you. You might be making a mistake, which they might pick up. In which case, it's great and you fix it up."*

Although, most of the group discussions were positive, there were concerns that over assistance would impede a team member's learning experience in restricting his or her experimentation even when the intentions were good. For example:

Jack	*"I'm happy to help people but I tend not to. Because like I said sometimes it's better to. Like if we work together and say "you are making it swing too fast" or then all the runs will be the same. And if someone is better, let them get really messy and see if they can get it back because you are learning even more then."*

5.3.1.2 System Printout

Feedback was also available in the form of a system printout at the end of each exercise, which tracked all the engines movements and plotted the path of the vessel. During the observations, the researcher identified a trend where all the team members in the ship handling simulator would crowd over the printout at the end of each user's exercise and provide feedback accordingly. It would typically involve the discussion of decisions over particular actions and other participants offering theories to improve the run.

More importantly, the participants were able to identify the importance of the printout as it offered an objective analysis of the result of their decisions, and which they could carefully reflect upon individually and in a group. For others who had yet to complete the exercise, it provided a focal point of how the participant would approach the exercise where they hoped to learn from the faults of others. The printout also emphasised the view that feedback, or response, from simulators do not have to be instantaneous to be valuable as the participants had shown. To illustrate:

Alvin	*"Well it's great that at the end of the exercise you get a printout and see exactly what we've been doing at each stage. From that, if something has gone wrong, you can work out from what we have should be doing at that stage..."*

John	*"...this printout is a fairly important feature since we can see what we've done."*
Jordan	*"...we all discuss afterwards what's going on [with the printout], compare what we've done, and you sort of focus when you do it."*

5.3.2 Learning Styles

As the ship handling simulator was a user-centred learning tool, the type of learning style made an influential impact on the participants' attitudes and behaviour regarding learning. They felt that the simulator was much more accommodating to their individual needs, as opposed to the classroom, and that it stimulates a response in learning that they found constructive and valuable. This led to greater interest and commitment to the learning material since they were not just assimilating information but processing and applying it in the simulator in real-time or close to it.

The participants also recognised that the passive learning style environment (in the classroom) was not strategically aligned to meet their learning objectives. They expressed it as unfulfilling, mainly, in how the material was taught and could not perceive the immediate value in the content. As a result, they lacked focus, concentration and found it difficult to memorise what was taught in the lectures or the classroom. For example:

Bert	*"...a lecturer up there saying "turn left", "turn right", "go easy on the throttle" and that sort of stuff, you wouldn't learn anything."*
Alvin	*"In the classroom you are just being fed all this information ...I kind of forget the stuff."*
John	*"In my opinion, ship handling is not a classroom subject, it's so practical - it's very hard to teach. It has so many variables..."*

Duncan	*"Mainly just the application of what is written down and trying to remember it..."*
Charlie	*"The difficulties in a classroom are the one-way learning process can be a bit tiresome in the sense it can get pretty boring but the subjects are dry so I don't know....*

Nonetheless, there were still participants that support the need for both learning in the classroom and in the simulator. For example, Charlie acknowledged that both styles offer a '*knowledge*' and '*skill*' component to his learning process, especially for a mature age student such as himself. With the transition from seventeen years in the Navy to the Australian Maritime College, he felt the classroom was an effective method to fulfil missing aspects of his maritime knowledge. Another participant, Duncan, revealed that having access to the simulator had increased his interest in the classroom, mainly in the areas of focus and attention. This view was supported by Bert as well who believed the simulator should be offered with more classroom-based subjects as he could clearly perceive a relationship between the material in the classroom and application of the content in the simulator. For example:

Charlie	*"I think that's great because with all the experience you might have a lot of it you might have picked it up on the way but when you come back to the books in theory there's still things there you took for granted or didn't know in the first place. So it's a necessary evil in a way...."*
Joe	*"Sometimes you've got to road learn and the quicker they get it out, structure it and do exam situations. When you can past the exam, you can carry those skills to your practical... You can play with that bit of knowledge."*
Duncan	*"...you need some idea what should be expected to happen from a handling point of view."* *"Sometimes lecturers standing up in class has its place..."* *"We get to discuss the procedures during the class in what we are trying to achieve and put it into practise makes it worthwhile, and makes you pay more attention in class then you would otherwise."*

John	*"So for ship handling, you can't really....you can learn a certain degree about it in class but it won't be as good [without the simulator]."*
Bert	*"Our batch of education is related to our work in the simulator...what we actually learn and what we've been taught, we can do in the simulator."* *"I personally think we should be spending more time with it and combining [more] classes into it."*

When the participants were questioned about the style of learning and approach offered by the simulator, their attitude and behaviour was very much opposite to learning in the classroom. In taking an active approach to learning, they were able to clearly distinguish the intimate and immersive nature of the technology. The participants were also able to establish a relationship between the learning outcomes and the simulation exercises, and identified the reasons for it. For example:

Bert	*"...the simulator stimulates more constructive, positive learning and analysis. Where in a passive learning environment, I don't find it, from a learning perspective; I don't get as much out of it as in an active environment."*
Jack	*"This is more for yourself."*
Anthony	*"I enjoy self-directed [learning] with a little teaching input is good because I like to figure it out myself anyway. So it's good with Ian just telling us what to do and then leaves. Like it can astray like last week when I stuffed up a bit and you learn from your experiences as they say."*
Alvin	*"It's a great way for us to work; it gives us a bit of freedom to sort of adapt to what we need to know."*
Joe	*"....standard teaching will teach you the reactions, ship clearances and all this. Every ship has it own characteristics and until you try a certain class ship, you won't know its true characteristics."*

5.3.3 Perceptions

When the participants were questioned about how they perceived the role of the simulator in their learning process several underlining issues were identified. A majority spoke about a shift to user driven learning; the necessity to validate, attain and regenerate knowledge and skills; and the opportunity to experience ship handling in different situations.

5.3.3.1 User Driven

The participants perceived a pattern where learning in the simulator is much more user or self-driven, and that they discover this shift in responsibility to be encouraging. They express a change in their attitude where they can value the skills they learn and rely less upon the instructor in the simulation exercises. For example:

Alvin	*"...in here you learn for your self."*
John	*"He's good like this. Shows us and goes".*
Anthony	*"I enjoy self-directed learning with a little teaching input is good because I like to figure it out myself...Like it can astray like last week when I stuffed up a bit and you learn from your experiences as they say."*
Charlie	*"...it is essentially your skills that get you there, and only your skill. You can't copy off anyone else or do anything like that, you just got to get up there and do it."* *"Once you are in the hot seat, you're focused on achieving the outcome required which is to manoeuvre in a certain way. It demands a high level of concentration and focus."*

Interestingly, when Bert was asked to clarify the greater learning emphasis on the user, he highlights the issue of *challenge and response*, considered to be a critical aspect of Bridge Resource Management (BRM). He states that it is sometimes necessary to intervene in the decisions of senior officers higher up in the command hierarchy if he believes a certain command or decision is flawed. As Bert explains:

Bert	*"...part of bridge resource management is challenge and response, you know? We've got to do that out there. We joke about it and all that kind of stuff but we have to say like "I think you should turn" and other stuff."*

5.3.3.2 Knowledge

Jack and Duncan held perceptions that knowledge was attained, refined and regenerated through primarily participating in the simulation exercises and observations of other users. For example, Jack points out that "*...it's good watching other people make mistakes and try to pull them selves out of it.*" The simulator provides the ideal platform to bring together material from other sources, including the classroom and previous work experiences, to construct new knowledge in a testing and high-pressured environment. For example:

Duncan	*"I think it refines and brings together a whole lot of different bits-and-pieces you sort of pick up. With the teamwork again, having an understanding of what the (ship) master is trying to do, getting an overview of the situation, understanding the different roles of the different people involved in the team."*
Bert	*"It highlights what they've been teaching you in the classroom, it really does. I've been through it you know? What you learn through the classroom you come in here and put it into practise to find out how useful it is and what kind of environment you need to use it in."*
Charlie	*"I believe it has contributed enormously. I can't wait to use these skills and get out there to do it a few times and therefore let it sink in."*

5.3.3.3 Opportunity

The participants held the belief that in employing the simulator, it was an opportunity to experience ship handling, play various roles, and one that would help further their careers in the future. A majority of the participants have previously little or no experience with large (merchant) vessels, and lacked the qualifications to fulfil a senior (bridge) personnel position. The simulator changed this. More specially, it enabled them to play roles that validated their theories, either picked up in class or from other team members, and transform it into knowledge that they could later apply in the real world. For example:

Anthony	*"Before it was all theory and you think you will be able to do it but you don't know until you get in there and try it."*
Jack	*"We learn this stuff in the classroom basically. The lecturer telling us what about a boosted turn and we come do it in the simulator...we can see it work."* *"Just getting experience of handling different ships and a few different skills you wouldn't have, like I said, you wouldn't get at sea."*
Charlie	*"A much better knowledge of how big ships handle. Increased draft, increased mass, increase of momentum, and just how to pull up in a straight line."*
Duncan	*"It gives you the chance to play all the various roles rights from the captain's position through to helmsman, and all the rest."* *"Out on a ship, under normal circumstance, you probably won't have a lot of chances to practise what you are doing here...."*
John	*"....as a cadet...you don't get any opportunities to do ship handling in real-life on a ship like this....It's good from that point of view."*

Furthermore, the participants expressed that in undertaking the exercises in the simulator, it increased not only their experience and understanding of different vessels, but also their career potential. To demonstrate:

Duncan	*"...head and shoulders above the rest."* *"Like getting on something this size and finding out how it behaves is going to be an advantage (in the workforce) then."*
Alvin	*"Oh definitely. I've never handled a ship of this size..."*
Anthony	*"Well this is good as it prepares you for the actual on-the-job training."*
Jack	*"It's good because, for me, I don't have much big ship handling experience..."*

5.4 Core Category: Constraints from External Forces

Constraints from External Forces
2.1 Inhibitors
2.1.1 Course Criteria
2.1.1.1 Limits Decision Making
2.1.2.2 Fear of Failure
2.2 Time Constraints
2.2.1 Limited Simulator Access
2.2.1.1 Lower Experimentation
2.2.1.2 Lack of Freedom
2.2.2 Compact Course
2.2.2.1 Low Performance
2.2.2.2 Increased Pressures
2.3 Technology
2.3.1 Simulator Limitations
2.3.1.1 Object Visions Problems
2.3.1.2 Depth Perception Issues
2.3.2 Dependency
2.3.2.1 High Reliance on Technology
2.3.2.1.1 Requires Underlying Support from Real Experience
2.3.2.1.2 Invading a Legitimate Art

Table 5-3 Constraints from External Forces

The learning development of participants in the ship handling simulator is perceived to be limited and constraint by a set of external influences (see *table 5-3*). Each external influence impacts the respondent in differing ways from lower user experimentation to being over dependent on technology for student learning. Fortunately, a majority of the respondents acknowledged these influences and make every effort to achieve his objectives regardless of these impediments.

5.4.1 Inhibitors

There were some participants who perceived the course criteria as an inhibitor and highlight it as having a negative impact on their freedom to experiment in simulation exercises. For example, two participants seem so focused on the criteria, and the fear of failure, that it lowered their risk tolerance. To illustrate:

Jordan	*"Well there's probably a number of ways to do each thing...each scenario. But you got a set of criteria, you've got to meet. You could go a lot faster sometimes or slow down quickly but you've got a set of criteria to meet. So, it's all about the criteria."*
Robbie	*"There is a small problem with it is that we have ten of these to do over the weeks and we don't want to fail them or the criteria. So, we don't want to experiment too much and we don't want to find out on a midst of a ship or whatever because you want just to get through it."*

5.4.2 Time Constraints

Time constraints were identified by a majority of the participants to be a significant area of concern, which ranged from the time available to utilise the simulator to the compactness of the course. This appeared to have affected more lateral thinkers who wanted to complete exercises from a different approach than what the instructor had previously shown.

Jordan and John expressed their concerns over the length of the course regarding how compact it was and that there was very little freedom to achieve the objectives of the exercise from their perspective. Duncan also commented on this issue by saying the simulation sessions are typically "*twenty five minutes so you are not going to do a lot...so, there's not a lot of freedom...to approach it from your own view and experience*".

Joe and Bert also outlined their concerns regarding the limitations of time but accepted that achieving the goal is more important than the means. When questioned about the available simulator time, they responded:

Joe	*"We don't get a lot of time in the simulator per se because if people take turns the real time is only your helm time, which should be 30 minutes and if you stay for each manoeuvre you might get another hour out of it once a week..."*
Bert	*"There are time pressures on the course that we are doing on a whole; it's not just on the scenario we dealt with last week. Like if I had a day to sail around with this ship, it wouldn't be a problem being along side but given the time constraints that we've all got it was difficult at the time and that's what let me down a little bit."*

5.4.3 Technology

All participants perceived the simulator to be an excellent learning tool for individuals with limited ship handing experience and qualifications in the real world, however, they also perceived problems with it. The participants, in particular, Alvin and Joe shared similar opinions on the problem of depth of perception in the simulator. As the three dimensional environment is projected on to two dimensional screens, it was an expected problem and one the instructor often pointed out in the simulation exercises.

Alvin	*"The only problem with the simulator itself is the night time simulation, you've got sort of depth perception. All your beacons are one big blob and all you see is one big great line unlike on a real ship..."*

Joe	*"Critically it's the vision. I say it's real but it needs a certain amount of adaptation because depth of field is incorrect, it's not real life. You look closer to things but they are not really. So the actual visual perspective can't be relied on but the instrumentations match it up so it's blind pilotage in a lot of ways. I don't look out there too much because it's technically incorrect."*

Charlie expressed his concerns regarding the over dependence on the simulator as a learning tool when it is no substitution for the real experience at sea. He agreed that the simulator has a role in the development of ship handling skills, but there is a certain limit to how far that can go. Charlie comments:

Charlie	*"I don't like to see it overrated in terms of picking up real time experience at sea against simulation time. Simulation time is an important tool and there are things to be tested in terms of your skills. But the real experience, in my view, supported by simulation experience is at sea. There's only a fine eye point where the simulator can bring you to. It's a great tool for pilots to come down and train because they can train under different conditions and experiment with different types of ships, different conditions. Ultimately, it's got to be done out there where the buck factor is a lot higher when you're out there."*

When asked to elaborate on these limits, he described that being a mariner is an art, and tools like the simulator may change the future perceptions of ship handling to be more of a science or a technocrat. To illustrate:

Charlie	*"...the simulator has a distinct role in the development of skills and development of, I say, a harbour, and testing people under different scenarios and conditions. What I'm trying to say is that being a mariner is an art not a science but the science is invading a perfectly, legitimate art, and changing its paradigm about 180 degrees. So people, probably in the future, will see themselves as technocrats and not artists. Maybe the art is dying? Maybe sea faring is a dying art? I like to think it's still an art and the science therefore is just a tool. It just supports but doesn't dominate. It's there when I need otherwise I'm a sea farer and it's an art."*

From the discussion above, it is clear there are some fundamental shifts in which the participant expressed his concern on the impact of ship handling simulators in their industry, and is apprehensive by the invasion of sea officers seeking perfection facilitated by technology, rather than experience or instinct gained at sea.

5.5 Core Category: Team Relationships and Structures

Team Relationships

- 3.1 Relationship
  - 3.1.1 Mateship
    - 3.1.1.1 Support
    - 3.1.1.2 Apprehensive of Mates' Failing
- 3.2 Structures
  - 3.2.1 Ad Hoc
    - 3.2.1.1 Equality of Members
  - 3.2.2 Authority
    - 3.2.2.1 Weak Chain of Command
      - 3.2.2.1.1 Negative Consequences - Abuse
      - 3.2.2.1.2 Difficult to Enforce
      - 3.2.2.1.3 Undermines Bridge Resource Management
- 3.3 Social Network
  - 3.3.1 Team Building
    - 3.3.1.1 Improve/Refine Team Skills
    - 3.3.1.2 Assist in Maximising Learning Potential
    - 3.3.1.3 Pressure to Perform - Positive
  - 3.3.2 Introduces Self Belief and Confidence
  - 3.3.3 Sharing of Experiences and Information
    - 3.3.3.1 Offer Alternative Solutions
    - 3.3.3.2 Question User's Actions

Table 5-4 Team Relationships and Structures

The development of team relationships in the simulator was based upon three essential elements of relationships, group structure and establishment of a social network (see *table*

5-4). The participants perceived the development of the relationships to come from contributions of individuals through a genuine desire to assist their mates; a flat team structure that endorse the equality of members; and a social network that supports team building initiatives.

5.5.1 Relationship

An underlying theme identified by participants that both engaged and supported learning, was a close relationship, particularly mateship, between team members. The researcher often noted that support was often given when a team member was uncertain in how to approach a problem or objective, and input would often be forthcoming. As Jack explicitly states "*...you do it because they are your mates*".

When Jordan was asked whether input at the wrong time would limit other team members' learning, he agreed, and responded by saying "*...he was guilty of it himself*". He then tried to justify his intentions by explaining:

Jordan	*"But people tend to.... you don't want to see your mates fail and come back to do it again so you want to, as in a real ship bridge, it's exactly the same. You don't want to run aground and if you see something you mention it to whoever's got the con..."*

5.5.2 Ad hoc Structures

Although the simulator setup attempts to replicate a real ship bridge environment in regards to the command hierarchy, the structure is rarely enforced. The result is a more informal and level-playing environment that encourages communication and sharing of ideas and solutions between team members. However, in certain circumstances, it is necessary for it to be enforced when participants including Bert and Jack wanted other team members to perform well. To illustrate:

Bert	*"It's difficult in this situation because in what we were saying earlier on that we are all on level medium here and there is no chain of command. So you really need to establish a chain of command to be able to – I guess that would be a positive thing if you could create – which I think we will in time when we get more serous situations, where everybody has to hold their positions properly because we got to perform. In that case, we get a lot out of it. Like when you have collision avoidance, there is a lot to think about and what not..."*
Jack	*"One of the bad things sometimes, there's five people in there who are quite knowledgeable and they all have different ideas, and quite often, people won't let the captain just command...at sea. Like the guy on the helm would say "oi...I don't know if you want still to be hard over" or you know "you want to think about slowing down here?" It might ok happen on a ship but sometimes its good to let people make mistakes..."*

Anthony believed the ad hoc structure could also have other disadvantages because of the weak chain of command. He commented that certain people he worked with previously in other (smaller) simulators became too assertive and might not execute a given command because they believed it was wrong or inappropriate. He stated:

Anthony	*"...there are some people that still think that despite what order you issue they think they know better and might do whatever they feel is best. But in the group of students I'm in at the moment, it would be abided and if they had a problem with it they would say "is this right?" or "shouldn't you be doing something like this instead?""*

Jordan and Duncan also outline their viewpoints on the ad hoc structure as being a positive setup because even with the different level of experiences amongst the team, they still feel they can freely contribute to the team.

Jordan	*"I think most of the guys have said that it's good we are all at the same stage with different experiences – some of us have been on ships on similar sizes to the models that we are using, some have been on smaller and so we all have inputs, thoughts and everything. Sometimes it's all about team work – bridge team work – and so it can be good."*

Duncan	*"I think the most engaging thing in a simulator is the team work associated with it. Everybody has their particular role but basically because we are at the same level it's still good to discuss with others ideas in how to solve the problems that are created."*

5.5.3 Social Network

The participants perceived the group was connected via a social network where they can freely question and discuss the actions of other group members. It provided a platform where they could effectively undertake team initiatives; induce self-belief and confidence; and where they may share information in either a formal or informal manner. For example, a social network does not only provide a means of communications but also assisted in the integration of new members and also a sense of team as highlighted by the participants below:

Jack	*"Well there are always people with antidotes with about times coming to Newcastle...or Sydney. So it's all quite interesting and to talk to the guys from a broad range of ships."*
Duncan	*"This being my second block, I know most of the guys but some of them only come in the last month. It builds a sense of team amongst those who just came."* *"I like to think everybody in the group feels free to offer their own perspectives on it..."*
Charlie	*"I'm a team player in the sense that I expect people to chirp up and chirp in. When I'm on the bridge, I encourage that among people."*

The researcher also identified that team building initiatives and exercises to play a significant role in the adoption and perceived value of a collaborative, simulation setting. The participants expressed the view that there are linkages between their performance and how working in a close-knit team improved their ship handling skills through increased self-confidence, team focus, transfer of shared experiences and fostering of an environment where team members could feel comfortable in giving input when required. For example, Duncan justified his response by outlining examples of how the team influenced his learning by stating "*it improves your self confidence and belief in your own abilities and to get the best out of people as well.*"

However, not all agreed with Anthony who was more doubtful about teamwork improving his soft skills, but rather perceived it to refine the skills he already had. He stated:

Anthony	*"I don't know if it's improved – more brushed up the skills you've already got. You do refine it a bit because at sea you probably not in team work so often... So it's more brushing up on the skills you've already had."*

Several participants commented that pressure was an influential factor when working in front of others and some even described making mistakes as embarrassing but conceded it was part of the learning process. As Alvin explained "*...you certainly don't want to look like an idiot in front of anybody else*" and followed up by saying "*...we all make our stuff ups at various times in this so there is not a huge embarrassment that you wanted it to turn out right*".

Jack acknowledged the pressures in the simulator, and drew on a real-world comparison, by saying "*...it's something you got to get used to working with other people, and there is extra pressure with other people around watching you. I mean it's good, it's more like how it going to be.*"

When Charlie was questioned about teamwork and how it could improve his learning, he outlined the value of shared experiences and opinions in his response:

Charlie	*"We just did it then talking about speeds, and just coming around so definitely there is shared experience there. People might say they will try this way and you say yeah and when they do it they may have come around a bit fast. So there's definitely shared experience and that's the beauty of the simulation. Oh everyone can sit there and say 'maybe I would do it this way' and you experiment to try different things...So there's definitely value in sharing experience out there."* *"Shared ideas are good ideas and people should feel their ideas are contributing to the greater whole."*
Alvin	*"Yeah. There is a lot to learn from other people's experiences."*

Anthony was more critical regarding the need to share experiences and opinions, as he believed that "*the teamwork is there to use each other as sounding board. If someone is doing something wrong, you actually suppose to say something.*"

5.6 Core Category: A Desire for User Engagement

A Desire for User Engagement

- 4.1 Interactivity
  - 4.1.1 Social Networks
    - 4.1.1.2 Share Experiences
      - 4.1.1.2.1 Team Bonding
      - 4.1.1.2.2 Increased Knowledge
    - 4.1.1.3 Understanding
      - 4.1.1.3.1 Strengths of Team Members
- 4.2 Motivation
  - 4.2.1 Heightens Emotions
  - 4.2.2 Increase User Commitment
  - 4.2.3 Real World Applications
    - 4.2.3.1 Role Play
- 4.3 Challenging
  - 4.3.1 Test
    - 4.3.1.1 Benchmark Skills
    - 4.3.1.2 Determine Level of Competence
  - 4.3.2 Objectives
  - 4.3.2 Self Reflection
  - 4.3.3 Sense of Achievement
- 4.4 Meaningful
  - 4.4.2 Relevance
    - 4.4.2.1 Practical Oriented Exercises
    - 4.4.2.2 Employs Simulated Real-world Ports
- 4.5 Simulated Environment
  - 4.5.1 Safety

4.5.1.1 Freedom to Experiment 4.5.1.2 Act without Consequence

Table 5-5 A Desire for User Engagement

The participants strongly expressed a desire for user engagement at various stages and levels of their learning in the simulator. They perceived a number of factors that stimulated engaged learning and the contributions that made the whole experience meaningful and worthwhile.

5.6.1 Interactivity

The participants identified that social interactivity in the ship handling simulator to be one of the engaging aspects of their learning rather than just interaction between the user and the simulator. This social interactivity helped heighten interest in learning because the participants were able to probe and question other participants' actions and decisions. This also appeared to result in encouraging team members to identify and notify any errors of judgment made during a simulation exercise.

More importantly, the social interactivity played a significant role in the exchange of shared experiences since the informal manner of the relationship provided a non-threatening and relaxing environment to communicate freely. For example:

Anthony	*"There is cross communication between people so if you are starting to make a mistake they can bring you up on it. It does help you a bit since it increases your skill levels and you won't do that mistake again. Well hopefully not."*

Jack	*"Well there are always people with anecdotes about times coming to Newcastle or you know this like what you do when you come into Sydney and all this. So it's all quite interesting and to talk to guys from a broad range of ships."*
Alvin	*"Just the group work and learning off each other mistakes and other things that each of us done well. "*

5.6.2 Motivation

A key theme in the study was the high level of self-motivation from a majority of the participants. This emerged from a number of reasons including a commitment to learn, the sense of achievement and competition within the team. The participants, Duncan and Anthony, shared similar opinions about the influence of motivation, mainly in that they observed the classroom to be tedious and abstract to real life. In the simulator, they could distinguish a stronger association with real ship handling activities. For example:

Duncan	*"I think this more than doubles that sort of aspect of it. Its all well and good reading stuff out of text books or getting people standing up there talking about it. But the fact here we get to discuss the procedures during the class in what we are trying to achieve and put it into practise makes it more worthwhile..."*
Anthony	*"I think when you are stuck in a classroom; it's abstract to what you do in real life. But you get in here; it is pretty close to what you will be doing. It is interesting; you actually see where this is going and what it's for, where with some of the other stuff you don't..."*

Bert was much more direct, and simply replied, "*...this is what you want to do – I mean – we are here because we want to be here."* When queried about losing his temper in one of his simulation exercises, he commented that:

Bert	*"You got to appreciate that I'm interested in what I am doing and I want to do well. For me to lose my temper, I was a little upset not being able to bring the ship broadside. The simulator wasn't co-operating with what I wanted to at the time. That was basically it!"*

John and Charlie had different reasons to stay motivated compared to the participants above and stated:

John	*"It is partially to a commitment to learn because at the end you can see exactly what you've done and exactly what's happened. But also a little of competition between people."*
Charlie	*"I think my learning in this simulator is self-motived. This is a bridge activity that I am used to."*

5.6.3 Challenging

Several participants identified an underlying component of engaged learning in the simulator was being challenged. When they attempted to define the exact nature of the challenge, the researcher was able to identify the main forces driving it. For a majority of the participants, it was revealed that the challenge of basic vessel manoeuvring and performing in life-like scenarios heightened the interest in the simulator, and the overall value in simulation learning. When the researcher dwelled deeper into this issue, the prospect of relying upon the participants' own skills and abilities to achieve the exercise objectives made it simply more worthwhile. In some cases, it resulted in the experience of an epiphany, a sense of achievement that would not be possible by sitting in a classroom only. For instance:

Jordan	*"Personally I've never done anything like this before like turning a ship around and all that stuff so it's challenging – definitely challenging. It's always good to be challenged mentally I think."*

Bert	*"I'm sure most people here would debate it. I think difficult or tricky situations, like last week, when things ain't going quite the way you want to..."*

Charlie's perceptions of the tasks were that it was more than challenging but also authentic and interesting. He felt quite a sense of achievement, as did Duncan, when he completed the simulation exercises because he relied upon his own skills, experience and judgement to make it through. To illustrate:

Charlie	*"I think they are very authentic, interesting and challenging in the sense you are challenged to meet a particular objective, and it is essentially your skill that gets you there, and only your skill. You can't copy off anyone else or do anything like that, you just got to get up there and do it. It's quite a sense of achievement to be challenged by in the first instance and achieving the award of doing it properly to meet the objectives."*
Duncan	*"At the end of the exercise there is a feeling of quite of an achievement, particularly, with the challenging exercises we are getting into now."*

Charlie continued to elaborate on his previous comment by saying:

Charlie	*"It's been better than that because it's been challenging so it hasn't been something 'oh I just do that'. It's interesting, it's challenging and you were talking about thoughts and feelings before, there's lots of thinking but there's feeling as well. The edge of feeling nervous about something and that's the beauty of the simulator, there is a thought and a feeling."*

This also demonstrates that participants had a genuine desire to be mentally tested in terms of their skills to determine if they had the ship handling skills to perform in a commanding role.

5.6.4 Meaningful

The participants identified that in order for learning to be effective and worthwhile; it has to be meaningful for the learner. The ship handling simulator makes significant contributions in this area. Its ability to generate artificial representations of coastal destinations around Australia and capture the characteristics of a range of shipping vessels provided the participants with the ideal platform for meaningful, contextual learning. Through it, the participants are able to identify the value in undertaking the exercises in a practical manner. For example:

Duncan	*"...It's still fairly simple but having the real areas to work in – simulation is based on a particular place – and they got places like Melbourne and through the Mallaca Straits. And so being able to base it on real places makes it a lot more authentic."*
Anthony	*"Basically what I've said that it is realistic and you do various scenarios – I think they've got it all around the Australian coast, which is most of the ports I be going to anyway so you get a hands on feel on those ports before you even go there...."*
Alvin	*"They are pretty practical; these are the kind of manoeuvres you will be carrying out on the ships. Apparently the ships are fairly realistic in their handling – a master on a ship said it was fairly accurate."*
Bert	*"Again, it's the practicality of it. You are thinking on your feet and I think this is good for practical people. We've all been to sea anyway so it brings us back down to the reality of being back on a ship."*

Charlie also highlighted that learning in the simulation environment is particularly meaningful because the simulated shipping vessels are very realistic, in terms of its behaviour and characteristics. It is also one of key reasons why it is considered to be a great tool. To illustrate:

Charlie	*"I think it's wonderful. I've spoken to Ian and asked him 'how does this compare with the real thing?' and he's quick to say this particular vessel we're using is 95% compatible, as said by the master of a vessel who's driven it. So I fully appreciate the benefits of the simulation, not only as a student but also as an instructor in a previous life in the WATSON simulator. It's a great tool."*

However, not all the participants believed in the value of learning in the ship handling simulator can be employed, or applied, in the real-world. One participant, Bert, expressed concerns about the skills attained in the simulator and how it can only be relevant in the simulator. He thinks that there is no substitution for real life experience and commented that:

Charlie	*"Although, it's only relevant that what we learn in here is relevant for what we use in here. At sea, you get the real sea experience and there's no substitution for experience in a certain field. Like pilotage, for instance, their expertise is in piloting a vessel into a particular port where a ship's captain who've captained his vessel for four years know how to operate. In here, what we learn over each week can be filed into our very own personal database."*

5.6.5 Simulated Environment

The participants held a broad set of perceptions in why the simulated environment facilitated engaged learning. One participant perceived it to be a transparent process where the instructor can determine the level of competence of the student, and others perceived it to be a learning environment where they can freely experiment and construct knowledge without financial consequences. For example:

Duncan	*"I guess it is to use a controlled environment where the lecturers can observe what's going on in order to give them an understanding where your level of competence is as far as command and control. Also, I think more importantly for each of the students to give somewhere where you won't aground and do millions of dollars of damage."*

Bert	*"What we actually learn and what we've been taught, we can do in the simulator. We are very removed from the real work but we can still put things into practise because they represent it well, although, not totally a realistic situation."*
Alvin	*"If you make a mistake in here it doesn't matter you just rewind it and start it again, which is something in our practical training on the ships we can't do. If we make a mistake, you go 'crunch' and there's trouble."*
Joe	*"...if you do it wrong the first time you are not in the Marine Court of Enquiry, you push a button and do it again."*

When the participants were asked about the role of the simulator in their overall learning process, most perceived it as a valuable tool because of the visualisation elements, but also the realistic environment that it was able to generate in response to their actions. For example:

Anthony	*"It is realistic to a certain extent and it is accurate like all the parameters and ships are actually realistic to what would really happen if you say pull ahead actually happens to the ship that you are on. So that is the best bit and you are learning what would happen in real life."*
Bert	*"Just the fact it's a very visual thing and it's a very accurate model of the ship. We are not playing video games. In theory now, we've learnt a lot of big ship handling skills and that's not what a lot of people will get actually because we all use pilots and that sort of thing."*

Charlie agreed with Anthony that the simulator could only offer training up to a certain point. For instance:

Charlie	*"Simulation time is an important tool and there are things to be tested in terms of your skills. But the real experience, in my view, supported by simulation experience is at sea. There's only a fine eye point where the simulator can bring you to."*

5.7 Chapter Summary

This chapter presented a discussion on the core categories and sub-themes that emerged from the data analysis process. It offered insight and evidence of the participants' experiences and thoughts through a selection of descriptive extracts necessary to build a rich picture of the research findings. This vigorous exploration was to better understand the complexities of this phenomenon. The next chapter will interpret the findings in greater detail, and also compare and contrast the study findings to assist in adding to the current body of literature in this field of research. As a result, it will reveal the underlying issues regarding engagement in computer-based simulation learning, as experienced by participants of the Australian Maritime College's ship handling simulator.

Chapter Six

Discussions

> *"Science cannot solve the ultimate mystery of nature. And that is because, in the final analysis, we ourselves are part of nature and therefore part of the mystery that we are trying to solve."*
> **Max Planck**

6.0 Chapter Six – Discussions

6.1 Chapter Introduction

This chapter discusses the findings derived from the three stage data analysis process, and will attempt to compare and contrast these findings against the current literature. In taking this approach, the findings within this study may assist in extending the current body of literature regarding engaged learning in the field of computer-based simulations. Finally, this chapter outlines future research possibilities, the limitations of this research program and a set of case study propositions.

6.2 Learning Focus

The participants in this research program identified various forms of learning strategies and focus that was expressed to be important in undertaking activities in the Australian Maritime College's ship handling simulator. They identified feedback, support for differing learning styles and underlying learning perceptions to play critical factors in the effectiveness of user learning in the simulator.

In the literature review, see *Chapter 2*, discussions regarding the importance of feedback as a crucial element of student learning was highlighted in this study. The theme of social and system feedback emerged strongly in areas, such as, decision making, self-analysis and ability to complete exercises under pressured environments. However, the research was able to extend the literature in this area, mainly, a more rich analysis of the influence of different forms of response or feedback. It identified that feedback from a simulator did not need to be instantaneous to have an impact, as expressed by the participants regarding the AMC's simulator printout, and that constructive thinking and reflection was enhanced by feedback when the participants could discuss their actions and decisions with other team members or the instructor. Furthermore, it confirmed that the value of response is highly sought after as Gagne (1985) had previously identified.

Gagne explains that feedback elicit strong, individual performance and reinforce knowledge attained in simulation exercises.

The style of learning offered in the classroom in comparison to the ship handling simulator shared similar opinions on some findings in the literature; learners enjoy an active discovery approach to learning than a passive one (for instance, Keefe, 1987; Lockitt, 1997; King and Ryan, 2001). In a passive learning (or classroom) environment, some participants would complaint about content relevance, failure to recall knowledge/material to apply in the simulation exercises and maintaining an adequate level of attention. However, when asked about learning in the simulator, the participants held opposite attitudes and more positive opinions because of the active learning nature offered by the technology. It supports the general consensus that a simulator provides a more accommodating environment for engaged learning through the support of various learning styles and modes (Kolb, 1994), and as Keefe explains that:

> *"...each learner has distinct and consistent preferred ways of perception, organization and retention. These learning styles are characteristic cognitive, affective, and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment"*

However, this research contradicts some works (for example, Whitehead, 1929; Rogers, 1969; Bill, 1997) previously published in that older styles of user learning, particularly teacher-oriented learning, should be replaced by more user-centred approaches. The participants in this case study perceived different styles of learning to supplement each other, rather, than replace one or the other. As one participant highlighted by describing the need for a (lecture) theory component to fill in the missing 'gaps', even though it was "*boring*" and "*tedious*" at times. Also, the researcher discovered that access to the simulator influenced the behaviour towards other learning environments, specially, the classroom. Several of the participants began to show more focus and concentration in class, as they could perceive a relationship between the classroom and the activities in the simulator and the immediate value of the content - unlike previously. However, these findings can only be applied within this research program parameters, further studies is required before it can be more broadly applied.

Opportunity is another sub-theme heavily viewed as one of the key beneficial reasons for utilising the ship handling simulator and which was highly desired amongst the participants. They observed a linkage between the simulator and the opportunity to not only role play and gain ship handling experiences but also in their future employment outlook. It was also one of the key driving forces in the participants wanting to request more time in the simulator. Participants, such as, Duncan illustrated the value of the experience gained in the simulator:

> *"...98% of the job is standing around and staring out the window but it's the other 2% where you are stuck in difficult situations where experience in simulators can setup up your own situations, which is along the same lines, can be invaluable to the 2%."*

The ship handling simulator offers great latitude in accommodating various forms of learning and focus but it cannot fulfil every aspect of a student's learning requirements as demonstrated by some participants who still felt the need for lectures. It does, however, have great capacity to be a tool that facilitates learning in an accommodating, appealing, enjoyable and effective manner for specific applications and functions.

6.3 Constraints from External Forces

This research uncovered that external forces typically had a negative effect on the participants' ability to learn in the simulation environment. For example, time pressures from the limited access to the simulator and the compactness of the course were influential in the negative thoughts and feelings that surfaced from the participants. Along with the course criteria, it was identified as the two factors that limited the experimentation of the participants, and hence, reduced the emphasis of freedom on achieving goals and more of simply "*getting the job done*".

Regarding the current literature, a critical component of experiential learning stated by Bowden (1987) is allocating "*adequate processing time with clear summary providing a cognitive map of the experience*". Without adequate processing time to assimilate and reflect upon knowledge, individuals cannot maximise their learning and achieve optimal student scores and ultimately result in reduction of their opportunity to become competent shipmasters in the future. Kolb (1994) is another author who continuously stresses the importance of learners having the time for active experimentation in his four modes of learning model. Furthermore, a study by Statham and Torell (1996) into the impact of technology on student learning in the classroom revealed one of the essential conditions to maximise student achievement was better access to technology, and stated "*...in order to become an integral part of students' learning, computers need to be available for individual student use during extended periods of time*".

A key (and unexpected) finding that is lacking in the present literature is identifying criteria as a potential hindrance to user experimentation in simulators. As one participant in this study openly commented that:

> *"...there's probably a number of ways to do each thing...each scenario. But you got a set of criteria, you've got to meet. You could go a lot faster sometimes or slow down quickly but you got a set of criteria to meet. ...So, it's all about the criteria"*

Simulators (and generally the purpose of adoption of technology in student learning) are able to offer some exceptional opportunities to give students more choice and control of their learning. It is essentially a chance to develop higher self-esteem through the build-up of data to diagnose and track achievement of required and desired learner expectations (Gregoire, Bracewell et al., 1996). However, this finding indicates that course framework, in this case a set of criteria, may limit these opportunities and place greater pressure on learners to simply complete the tasks rather than experiment and maximise the value of learning offered by the simulator. Nonetheless, more research is required to better understand the influences of criteria in simulation learning before this finding can be applied to other ship handling simulator applications since this research is derived on data gathered from a small sample of participants and from just one higher education institution.

6.4 Team Relationships and Structures

The participants were very upbeat regarding the team structures and the outcomes from collaborative learning. Gokhale (1995) refers to collaborative learning as "*an instruction method in which students at various performance levels work together in small groups toward a common goal. The students are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful.*" This is reflected within the team environment when a participant noted the improvement in "*self confidence and belief in your own abilities*" and stated that teamwork helped "*get the best out of people as well*". Proponents of collaborative learning suggest there is enough empirical evidence that it does not only maintain interest but also enhances critical thinking through active exchange of ideas and shared learning. This allows learners to engage in discussions, be responsible for their own learning and thus become critical thinkers (Totten, Sills et al., 1991). There was sufficient evidence of critical thinking in the simulator as one participant illustrated: -

> *"We just did it then [when] talking about speeds, and just coming around so definitely there is shared experience there. People might say they will try this way and you say yeah and when they do it they may have come around a bit fast. So there's definitely shared experience and that's the beauty of the simulation. Oh everyone can sit there and say 'maybe I would do it this way' and you experiment to try different things. You watch other people do it and think 'oh maybe I should of done mine a little earlier' or 'maybe slow down a bit more'." (Charlie)*

Another finding to be added to the literature from this is evidence that collaborative thinking facilitated by computer simulators can enhance or improve critical thinking even at adult or higher education levels. Previously, most of the research on collaborative learning associated with technology have been conducted at the primary and secondary levels (Gokhale, 1995). More importantly, this research suggests that critical thinking is not driven only by the active exchange of ideas and shared learning (Totten, Sills et al., 1991) but also through shared experiences and observation of actions and decisions of other team members as highlighted by the participant Charlie.

The second finding in this core category is related to the ad hoc nature of the team structure that is observed by the participants to have a significant influence on the behaviour and conduct of team members in the simulator. Unlike the bridge of a shipping vessel in the real world, the chain of command within the team is rarely recognised or enforced. This has led to mixed results. For instance, it has been beneficial in fostering an informal environment for active exchange of ideas, shared experience and development of relationships, while on the other hand, orders may be disobeyed and some participants are permitted to give input at inappropriate times. One participant, Anthony, recalled previously that "*...there are some people that still think that despite what order you issue they think they know better and might do whatever they feel is best.*" This is perceived by the participants to be contributed from the acknowledged "*level playing field*" and highlights weakness in the chain of command. Furthermore, team members can at times give inappropriate input that was aimed to influence, or even undermine, the decisions of the participant with the role of command. However, in most cases, input was given with good intentions because participants stated reasons such as "*...you don't want to see you mates fail and come back to do it again so you want to*" but conceded that "*...sometimes it's good to let people make mistakes*".

This finding is an important insight into group dynamics regarding learning in a team-oriented simulation setting as there is very little literature on this issue. Most literature on this area tends to focus on issues including shared awareness, understanding of new ideas, active participation and student-to-student learning (Gasen, Roberts et al., 1996) but lack focus how team structures, particularly ad hoc types, can affect their learning process and outcomes. Therefore, this finding extends the current literature on computer-based simulations used to support collaborative learning in higher education learners.

6.5 A Desire for User Engagement

Few would argue the necessity of user engagement in student learning as the general opinion of the current literature points to learners achieving higher learning outcomes and scores, while reducing the workload of teachers (for example, Laurillard, 1994; Statham and Torell, 1996; Jeong, Taylor et al., 2000; Valdez, McNabb et al., 2000). From the data analysis, it was revealed that the participants perceived engaged learning to be characterised by interactivity, motivation and tasks that is both challenging and meaningful. Some participants identified that simply having the opportunity to work within a realistic, computer generated simulation environment heightened their user engagement. Although previous research have uncovered some of these characteristics, the researcher believes this study to be the first conducted on ship handling simulators in a higher education environment coupled with a richer analysis of the implications between the participants and identified user engagement characteristics.

It is evident that if learning takes place in an authentic context, students learn knowledge and skills with higher transfer to real-world applications (Kearsley and Shneiderman, 1999). This is reflected in this study, which confirms the current body of knowledge contained within the literature, as a majority of participants enjoyed the practicality of the exercises, and how they could see value in what they were learning could be applied in the workforce. Duncan and Anthony illustrate this point by commenting the following: -

> *"...It's all well and good reading stuff out of text books or getting people standing up there talking about it. But the fact here we get to discuss the*

procedures during the class in what we are trying to achieve and put it into practise makes it more worthwhile, and makes you pay more attention in class then you would otherwise". (Duncan)

"When you are stuck in a classroom, it's better abstract to what you do in real life. But you get in here; it is pretty close to what you will be doing. It is interesting; you actually see where this is going and what it's for, where with some of the other stuff you don't" (Anthony).

The last finding in this study is the growing danger of the ship handling simulator on the mindset of the participants where mistakes (whether big or small) can be corrected by "*...pressing the stop button and restarting it*". This type of mindset can have a negative impact on student learning, as evident in flight simulators (Harris, 2003), and now suggestions that it also affect users in ship handling simulators. Even though simulators are designed to create a safe virtual environment without real world consequences, users should still make every attempt to approach the exercise if it was and ensure maximum effort is produced. If not, it may reduce the level of reflective and critical thinking and transform the simulator into a basic drill-and-practise tool without meaningful value. This may lead to similar problems on flight simulators where pilots are "simulator conditioned" (Harris, 2003), caused by overexposure to the training devices, and have difficulty adapting back to reality.

6.6 Propositions

From the results of the data analysis, and within the scope of the research program, the following set of propositions is considered by the researcher to appropriately represent underlying values, meanings or themes of the research findings.

- The participants perceive that the simulator cannot replace the real life ship handling experience in the maritime industry and can only fulfil one of the many facets of student learning.

- That traditional learning methodology, particularly classroom learning, still plays a significant role in the development of the participants with access to simulation technology.

- That access to the simulator has implications on the attitudes of the participants in the classroom environment, particularly, with regards to user concentration and understanding of material.

- The participants acknowledge that external influences are inevitable and understand the implications in their usage of the simulator.

- The relationships that exist between participants influence the structure of the team, which then has implications on the behaviour and conduct of participants in the simulator.

- That the simulator heightens the participants' desire for engaged learning and thus influences the (learning) value of the simulation tool.

- That feedback from the simulator and other group members is perceived to be a critical component in how participants approach their learning, in particular to decision making and self analysis.

6.7 Relation to Research Questions

Through the use of qualitative research techniques, this research has rigorously investigated the following research questions:

1. *How does computer-based simulation help facilitate engaged learning for the higher education participants in this research program, using the ship handling simulator at the Australian Maritime College?*

2. *How do the higher education participants perceive the role of the Australian Maritime College's ship handling simulator in their learning process, particularly in a team setting, and how do these perceptions influence their learning?*

With respect to the first question, one of the fundamental research findings was that the higher education participants perceived the ship handling simulator to be an effective vehicle for learning experimentation and self-analysis. It fostered an environment where participants found activities to be practical, ability to freely contribute opinions and provide an equal-level learning platform to accommodate their differing learning styles and levels of ship handling experiences. Furthermore, the participants revealed that access to the simulator was an opportunity to validate constructed theories with various forms of feedback that resulted in an increased understanding of ship handling.

The research also revealed numerous factors and sub-themes that influenced the participants' perceptions of engaged learning. These factors included social interactivity, motivation and meaningful and challenging tasks. These influencing elements can either negatively or positively affect the participant's perceptions of learning. Without the support of these elements, the performance and outlook of the participant would be typically below to those who otherwise did.

With respect to question two, the participants perceived the simulator as an important and necessary tool to their learning. The participants identified the simulator as an effective tool that could create scenarios employed to test, assess and measure each participant's competence and performance in a pressured environment. This would play a critical role in determining if they had the necessary qualifications to become a competent Shipmaster. As a team, they perceived a distinct pattern between the group structure and the behaviour and conduct of team members. For example, an ad hoc team structure creates an informal environment for active exchange of ideas, shared experiences and development of relationships but it also permits other members to influence, or even undermine, decisions of the participant in the command role.

Lastly, the influence of the simulator and its role seemed to have a positive effect on the participants' learning. They were encouraged to perform well since they could establish a relationship between the learning outcomes and the simulation exercises from the pressure and competition within the group. In addition, learning in the simulator altered some of the participants' perceptions towards other learning environments. For example, several of the participants showed a higher level of focus and concentration in the classroom, as they could perceive a relationship between the classroom and the activities in the simulator, and the immediate value of the content - unlike previously.

Overall, the Australian Maritime College's ship handling simulator made a significant contribution to the learning experience of the participants. It provided a safe environment where the participants could: freely experiment without safety consequences; learn ship handling with minimum industry qualifications; and construct their own knowledge and concepts. Without it, the course and the participants would simply not find it as worthwhile or enjoyable.

6.8 What the Research Achieved

Within the scope of this study, the research was able to identify the role of the Australian Maritime College's ship handling simulator in how to facilitate engaged learning, the impact it had on the participants, mainly how they approached their learning, what influenced their decisions and conduct and how they perceived the relationships in the team. More specifically, the researcher was able to identify the linkages that facilitated engaged learning, the simulator's influence on the behaviour and attitude of the participants and the impact on their process of learning.

The researcher also identified the implications of team dynamics and relations in a simulation environment and revealed the impact of how distinct structures influence the performance of the participants. However, little progress was made on how different group structures influence the performance and learning process of the participants due to the constraints of the research program. Lastly, the researcher believes the rich analysis of the Australian Maritime College participants during the time they spent in the ship handling simulator offered a firm foundation of basic theory for future studies.

6.9 Implications for Future Research

This study was in certain aspects exploratory as a social-technological research of this nature has never been conducted of the Australian Maritime College Simulator. The research sought to collect and analyse rich data from a limited number of participants. As such, it offers future researchers a sound basis for broader investigations into the college's ship handling simulator in the support of engaged learning theory and framework, how it should be implemented, and how to approach it to achieve high learning outcomes for students in a higher learning institution or environment. This suggests the requirement for further systematic research to authenticate the core categories and sub-themes identified in this study and ascertain the validity of the explanatory scheme.

In time, future research could attempt to discover the optimal combination of engagement elements that influence learning effectiveness in a computer-mediated environment, not just simulation environments. Certain elements seem to either restrict or demand the use of others, and further research could investigate and better understand the linkages between them. Also, it would be worthwhile to determine which elements create short, medium and long-term engagement for learners.

6.10 Findings Limitations

This research involved interviewing nine students in an attempt to gain a deeper understanding of their experiences, opinions and perceptions. Obviously, the researcher is not attempting to generalise the findings from a study of this size and type to all users who use the ship handling simulator for one reason or another. This study could not estimate or state what proportion of sample disapproved or supported the use of the ship handling simulator for learning or training purposes, as the sample was too small. Then again, that was not the purpose of the research, rather the researcher wanted a better understanding of the perceptions of the users of AMC's ship handling simulator via semi-structured interviews and observations.

Appendix A – Information Letter

UNIVERSITY OF TASMANIA

7th October 2003

To whom it may concern,

My name is Sam Lee and I am enrolled in a Master of Information Systems degree at the University of Tasmania, School of Information Systems. In order to fulfil part of the requirements of my degree, I am undertaking a study on AMC's ship handling simulator under the supervision of Chris Keen, School Head of Information Systems. The Northern Tasmania Social Sciences Human Research Ethics Committee has approved this research.

The purpose of this study is to gain an increased understanding into individual users' perceptions of ship handling simulations regarding engaged learning, particularly, in a team-oriented environment.

The study will be conducted with eight to ten participants, who have previous experience with the AMC's ship handling simulator. If you agree to participate in this study, you will be asked by the researcher to participate in a single interview. The interview's time and place will be negotiated between the researcher and you the participant, keeping in mind issues of comfort, convenience and privacy. It is anticipated the interview will last approximately half an hour. In this interview, you will be asked to share your thoughts, feelings and experiences on AMC's ship handling simulator. The interview will be audio taped and later transcribed into written form. I will review the transcripts in order to identify themes or patterns that may emerge from the interviews.

Confidentiality will be strictly adhered to, both during and after my research has been completed. You will be responsible to select a pseudonym, which will be used in all transcriptions and printed material. This will maintain your privacy, as it will protect from being identified. All electronic research data will be encrypted and password protected to ensure your confidentiality and paper-based material will be stored in locked filing cabinets located within the School of Information Systems. All (electronic and paper-based) data will be destroyed after it has been held for five years under the guidance of the school.

Your participation in this study is completely voluntary so you may decline to answer specific questions, have audio tapes containing your interview returned or erased, or even withdraw from the research at anytime. Results of this study will be made available to participants involved, and anyone else who is interested in this study. The findings from this study will be presented in a thesis and presentation later in the calendar year. It may also have the potential to be published in an academic journal.

Thank you for taking the time to read this information letter and I look forward to hearing from you soon regarding whether or not you wish to participate. If you have any complaints or concerns of an ethical nature, you may contact the Chair or Executive Officer of the Northern Tasmania Social Sciences Human Research Ethics Committee on.

Chair:	Professor Roger Fay	(6226 3576)
Executive Officer:	Amanda McAully	(6226 2763)

Regards.

Sam Lee
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0438362816
Masters Student
University of Tasmania, Australia

Chris Keen	Sam Lee
School Head of Information Systems	Master Student

7.0 Appendix B – Consent Form

CONSENT FORM

Title of Project: An investigation into the users' perceptions of engaged learning regarding the Australian Maritime College's ship handling simulator.

1. I have read and understood the 'Information Sheet' for this study.
2. I understand that my name, pseudonym and contact details will be recorded.
3. I have given my consent for the interview to be audio taped in a digital format.
4. The nature and possible effects of the study have been explained to me.
5. I understand that the study involves the following procedures:

   - A quick introductory overview of the purpose and aim of the research
   - An understanding and agreement to the guidelines set in the consent form
   - My name and contact details will be recorded for research purposes only.
   - An interview process that will be audio taped and last approximately half an hour
   - The interview will be transcribed.

6. I understand that no potential risks are currently anticipated with the interview. However, if the interview causes any distress or issues to me that require counselling services, contact with the researcher or chief investigator can be made to make such a service available.
7. I understand that all research data will be securely stored on the University of Tasmania premises for a period of 5 years. The data will be destroyed at the end of 5 years.
8. Any questions that I have asked have been answered to my satisfaction.
9. I understand since this interview is based on a voluntary basis, so I can decline to answer specific questions or even withdraw at any time.
10. I agree that research data gathered for the study may be published provided that I cannot be identified as a subject.
11. I agree to participate in this investigation and understand that I may withdraw at any time without any obligation.

Name of participant ____________________

Signature of participant ____________________ Date ____________

12. I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

    Name of investigator ______________________________

    Signature of investigator ______________________ Date ____________

8.0 Appendix C – Interview Questions (Round 1)

Interview Questions

Background Information

1. Do you have any other prior experience with simulation applications?

2. Do you consider yourself to be computer literate?

3. Do you mind explaining the reasons why you are using AMC's ship handling simulator?

Vision of Learning

1. What are your thoughts on self-directed learning where you have the freedom to decide how you complete your tasks inside the simulator?

2. Do you believe your motivation (or engagement) levels is increased when learning is supplemented by computer simulation and working collaboratively within a team?

3. What kind of advantages and disadvantages, in terms of learning, do you see in working in a team-oriented simulation environment?

4. What are your thoughts or feelings that you believe can improve learning?

5. One of the key engagements of training based simulations seems to be interactivity and system feedback. What are your opinions or feelings on this matter and do you see it increasing in the future?

Tasks

1. How do you find the tasks given to you from the lecturer? Are they difficult, challenging or authentic?

2. If you issued an order from the con, do you ever doubt your instructions will be executed? Why?

3. When allocated a difficult task, can you briefly explain any benefits or difficulties that you see working within a team?

4. In undertaking tasks in the simulator, what type of skills or experiences has helped you achieve your goals?

5. How practical do you find the tasks compared to the real world?

Assessment

1. Do you believe working in the simulator has increased your competence and performance levels? How has teamwork contributed to this?

2. Are there additional pressures or influences to do well or succeed in tasks when working with others?

3. Would you support the idea of peer assessment along with the existing self-assessment method? Why?

Collaborative Learning

1. Do you find that the sharing of experiences between students and the teacher contributes to your learning inside the simulator?

2. What are your thoughts on the current SHS training program developed by the AMC? Is it effective and structured in a manner where it builds upon knowledge gained in previous sessions?

3. How do you feel being in a team based simulation environment compared to learning as an individual?

4. Has working within a team improved your soft skills i.e. communication, listening and problem solving skills?

Teacher Roles

1. Since you have the freedom to explore and find your own way to achieve goals, can you see the role of the teacher become more of a facilitator or guide?

2. Do you in anyway believe or suspect that working in a team has been beneficial to both yourself and the teacher through the activities you have undertaken?

3. Are you comfortable with this type of self-learning as opposed to the traditional teacher-to-student directed learning?

Learning Expectations and Outcomes

1. Are you encouraged to teach or share knowledge/information with others in your team during your time in the simulator?

2. Can you describe some of the learning outcomes you and other team members expected from the ship-handling simulator program?

3. Did the experience align with your initial learning expectations?

Conclusion

1. Can you describe any problems you've encountered so far in the simulation sessions?

2. Do you have any suggestions that may improve the experience of the SHS from a user's viewpoint?

9.0 Appendix D – Interview Questions (Round 2)

Could you describe some of the differences and difficulties going from a passive to active participant in the learning process?

1. Which elements in the simulator created engagement?

2. What do you think are some of the important features of the simulator?

3. Do you think the simulator has enriched your learning? How?

4. How do you see the role of the simulator in your overall learning process?

5. Can you outline any issues that are supporting (or hindering) you from achieving your best inside the simulator?

6. Would you be happy to use computer simulators again in the future for ship handling and other applications as well? Why?

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